THE

Coffee Planter's Manual;

BY THE LATE

ALEX. BROWN,

KANDY.

TO WHICH IS ADDED

A VARIETY OF INFORMATION USEFUL TO PLANTERS,

INCLUDING

A SUMMARY OF PRACTICAL OPINIONS ON

THE MANURING OF COFFEE ESTATES,
&c., &c.

[THOROUGHLY REVISED WITH NOTES BY PRACTICAL PLANTERS IN 1880.]

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PREFACE

TO THE

COFFEE PLANTER'S MANUAL.

(*First Edition.*)

WHEN, at the request of the Proprietor of the *Ceylon Observer*, I commenced writing the *Manual*, it was with the double intention that it should be published first in "*Ferguson's Directory*," and again in pamphlet form—as a sort of *vade-mecum* that any Superintendent, Assistant, or Conductor, could without inconvenience carry in his coat-pocket, to the field or elsewhere. Both these objects demanded conciseness, and I fixed upon thirty pages as the probable quantity that would be convenient for the Directory, and sufficient to give a cursory description of the whole art and practice of coffee-planting. To confine my remarks as nearly as possible to those limits, I was obliged to touch but slightly on the various processes explained. Those considered most important, and those least likely to occur naturally to the mind of the beginner, received most attention. Compress as I would, however, the work has extended to forty pages. It has met with such a favourable reception at the hands of experienced practical planters, that, in reproducing it in this form, I feel bound in deference to the suggestions of some of these friends to amplify somewhat my remarks on *Lining, Roads, Manuring, Cisterns, and Estimates.*

THE AUTHOR OF THE MANUAL.

THE PUBLISHERS have to add, by way of explanation, that the principal portions of the information added to the Manual—and especially the Summary of practical opinions on Manuring—have been included by the

desire of several planters. Some useful letters, such as Mr. Tytler's on fixing iron-roofing, and one on the laying of asphalte, have also been re-published by request. A few other papers and tables which had not hitherto seen the light are given, in addition to copious extracts from valuable contributions to the literature of coffee-planting which appeared in the *Ceylon Observer*, and it is to be hoped that the whole will be found most useful and suggestive to the young planter as well as to all interested in the chief industry of Ceylon.

COLOMBO, 7th May 1872.

PREFATORY NOTE TO THE SECOND EDITION.

THIS little Manual has been generally considered one of the most concise and at the same time correct guides ever published for the young coffee-planter. It has now for some time been out of print, and in publishing a Second Edition we have taken the opportunity to lay the pages before three practical planters, whose Notes will be found prefixed to Mr. Brown's Manual. On the whole the opinion of the planting critics to whom we referred is that the little work is singularly correct even when considered in the light of eight years' additional experience. We have also taken the opportunity of adding to the book some seventy pages containing summaries of the latest discussions on Manuring, Chemical Analyses of Soils, Agricultural Experiments bearing on Coffee Culture, the Enemies of Coffee (White Grub, Leaf Disease, &c.), Estimates of Crops, Liberian Coffee Culture, and other practical subjects of interest to the young planter of the present day. We trust, therefore, that THE COFFEE PLANTER'S MANUAL of 1880 may be found even more useful and be more generally appreciated than its predecessor of 1872.

THE PUBLISHERS AND COMPILERS.

"CEYLON OBSERVER" OFFICE, April, 1880.

CONTENTS.

—:o:—

INTRODUCTION :—	*Page.*
Note on Estate Expenditure	I
Low-country Plantations and New Products...	IV
Note on Estate Roads	VI
Note on Estate Drains	VII
Note on Manuring	X
THE COFFEE PLANTERS' MANUAL :—	
Securing Land	1
Felling and Clearing	4
Lopping	6
Good Land	8
Suitable Elevation...	9
Desirable Lay	9
Favorable Exposure	9
Not Devastated by Wind	10
Nor Inundated by Water	12
Lining, Pegging, Holing and Planting ...	12
Planting under Shade	14
Holing *versus* Dibbling	16
How are the Plants Got ?—Nursery	17
Permanent Buildings	19
The Bungalow and Lines	20
Roads and Weeders	21
Draining	23
Topping	23
Staking	24
Supplying, Handling, and Buildings ...	25
Weeding	27
Pruning	29
Handling after Pruning	34
Manuring	35
Water Holes	39
The Bearing and Blossoming	41
Crop Time and Cherry Ripe	42
The Cherry Loft and Pulper	44
The Cisterns—Receiving and Washing ...	45
Tail Cisterns and the Barbecue	45
Estimates for Opening a Coffee Estate and Bringing it into Bearing	47
Lining	49
Roads, Manuring and Mixtures	50
Perindorge's Manure	51
Cisterns	53
Estimates...	55

CONTENTS.

Page.

THE COFFEE PLANTER OF CEYLON (being a review of Sabonadière's "Coffee Planter of Ceylon," by the Editor of the *Ceylon Observer*) :—
- Manuring 59
- Mana Grass 60
- Draining and Manuring 63
- Sombreorum 64
- Buildings 67
- Cost of Manures 68
- Enemies of the Coffee Tree 68
- Planting and Draining 71
- Estimates (Mr. Sabonadière's) 71

EXTRACT :—
- Estimate applicable to the Wynaad 74

Manuring Coffee Estates : by "Agriculturalist" ... 76

,, ,, ,, by "P. M." 78

How to Build a Chimney for a Hill Bungalow ... 80

Asphalte Flooring 85

Iron Roofing ... ... 88 & 89

Measuring Sawn Timber 89

Area of Land 90

Foreign Weights and Measures for Coffee ... 90

USEFUL MEMORANDA :
- Asphalte Flooring, Iron Roofing, Sound, Heat, Glue, Admiralty Knot, Water-power ... 91
- Heights with Sextant, Distances, Weight of Earths and Rocks, Rainfall, Roads ... 92

Potato Culture at Nuwara Eliya 93

Table of Coolies' Pay 95

,, of Kanganies' do 95

Distances, &c., of Plants 95

Estate Working Tables 96

Manure Tables 96

Cost of Coffee, Raw and Roasted 97

MANURES AND THEIR APPLICATION TO THE COFFEE PLANT : SURFACE AND SUB-SOIL MANURING (being summary of discussion by practical planters and other authorities in the columns of the *Ceylon Observer*) :—
- "Orum's" Letter 98
- Mr. Corbet's Letters ... ... 102 & 105
- The Coffee Tree Its Own Advocate : a Shuck Tree and a Tree Not Shuck ... 106 & 110
- Mr. W. Sabonadière's Letter 113
- "X.'s" Letter 117
- What is a Weed ? 119
- The Bracken as Manure 122
- Mr. Sabonadière's and Mr. Ward's Views ... 123
- Subsoil of Surface Manuring 125
- Mr. Thwaites' Opinion on Subsoil or Surface Manuring 129

CONTENTS.

Page.
Mr. W. C. Buchanan on Manuring and Manures 139
The Fertility of Soils 141
Dr. Sortain's Notes on Manuring 142
Mr. Thwaites' do do 144
Fertilizing Substances for Ceylon Coffee Lands 145
Mr. Mechi's Advice in applying Manures ... 148
Artificial Manures : Analyses and Cost of ... 148
COFFEE PLANTING IN CEYLON, according to the author of "Young Ceylon" ... 149
The Estimates in "Young Ceylon" and of Messrs. Sabonadière and Brown, by *Sceptic* 154
Brief Reply from Mr. Brown 157
Further Correspondence 159
Coffee Planting in Natal 160
How to Prepare Coffee in Roasting and Cooking 162
Coffee Prices in London since 1845 165
How to Prepare Soils for Analysis ... 168 & 169
THE COFFEE PLANTER'S MANUAL: SECOND EDITION :—
Directions for Taking Samples of Soil for Analysis 174
Crop Estimates 175
How to Buy Artificial Manures : Voelcker's Rules 176
Hints for the Consideration of Coffee Planters. 179
Coffee Trees in 1870 and 1880 181
An Answer to the above 183
Pedigree Wheat and Disease-proof Potatoes ; and Why Not Fungus-proof Coffee ? ... 183
On Manuring Coffee 185
Artificial Manures *vs.* Cattle Manure ... 189
Artificial Manures for Coffee 204
Mr. Hughes' Handbook of Ceylon Soils and Manures 206
Mr. Hughes' Analyses of Coffee, Fruit and Leaves, and the Conclusions They Lead to as regards Quantity and Quality of Manure 208
The Enemies of Coffee :—White Grub .. 223
The Campaign against Cockchafers and Grubs.. 227
Grub and the Coffee Tree 229
White Grub 230
The Grub Question : A Planter who is No Scientist Argues for No Delays in Destroying the White Grub, as the Enemy of Coffee... 234
An Old Planter on His Campaign against Cockchafers and His Remedy for Grub ... 234
Nitrate of Soda a Cure for White Grub : "Try it" 236
Agricultural Experiments 237
Shingling... 239
Land Suitable for Coffee 241
Rules for the Treatment of Liberian Coffee ... 241

NOTES TO THE COFFEE PLANTER'S MANUAL.

(By an old Planter.)

NOTE ON ESTATE EXPENDITURE.

The financial question lies at the root of coffee planting, as of every undertaking, and it behoves the person who thinks about opening an estate to consider very carefully the amount of his resources available within four years. He will have abundance of counsellors to tell him how much he can accomplish with any given amount, but if his own judgment is not a pretty sound one, he may find a good deal of difficulty in deciding between the eminent planter, who tells him that coffee has been brought into bearing for less than R100 per acre, and the other experienced hand, who warns him that it will take R250 per acre all out, to create a complete coffee estate, and send its first crop away. Should the enquirer be of a sanguine temperament, he will probably accept the lowest estimate for expenditure, and the highest for crops; with a capital of from R20,000 to R30,000, he will open the standard 200 acres, spend all his money before he gathers a berry of crop, commence borrowing, get deeper into debt every year, up to say the seventh; when the estate goes out of his hands for less than the debt on it, and he is free to begin the world anew unencumbered with any of the filthy lucre that encouraged him to undertake more than his means could accomplish.

Another way of going to work has had its advocates, and its actors, namely, scamping all the work done, from the felling to the gathering; having no roads, no drains, no decent buildings; leaving weeding till there is something important to be done in that way, and then spending as much on one weeding as would

have served for twelve if taken in time; creating in fact not an estate, but so many acres of bad and neglected coffee, that, if it is ever wrought into an estate, will cost much more, and be much less satisfactory, than if everything had been properly done at the right time.

As coffee land may now cost anything from R50 to R200 per acre, it is impossible to say what an estate should cost, with the price of the land included. Indeed the most skilful planter can only come near the mark of probable expenditure, when he has the cost of the land before him, knows the locality, the distance from a cart road, the probable amount of contributions to roads, medical wants, &c. On the whole, the planter who proposes to open an estate will do well if, after paying for his land, he resolves not to open an acre, for which he cannot command R200 within four years, without depending on any return from his crop. It is always the truest economy, to do well and substantially the work that has to be done; for, depend upon it, other things being equal, the most complete job of work will pay best. He who attends most carefully to have the underwood spread flat on the surface, who sees that the trees are properly cut to fall in one direction, and who insists on the large branches that stand up in the fallen forest being laid down, will have the best fire, and save both time and money thereby. He who traces, clears, and partially cuts his roads at the earliest possible time will save five per cent on all the work he has to do in the field. He who within the second year puts up permanent substantial buildings, for lodging his coolies and himself, will save more than he who repairs or renews temporary lines and bungalow. He who makes 18 × 18 inch holes will have better and more forward plants than he who is content with half the size. He who completes a good system of surface drains earliest will lose the smallest proportion of his surface soil. He who begins systematic weeding three weeks after the fire, and weeds all over within every subsequent month, need never spend even so much as R10 per acre per annum to keep his estate perfectly clean. He who from first to last concentrates the bulk of his labour on whatever job is

for the time most necessary, will effect a vast saving on the expenditure of him who endeavours to carry on many works at one and the same time. Finally, he who administers half a pint of lime and 4 oz. of bonedust to each plant when three months out will reap an abundant return in due time.

The planter who is well up in the what, the when, and the how, of estate work, and works up to his knowledge, can in an average case bring his estate into bearing for less than R200 per acre, and have everything ready and in good order for the first crop, but I think no prudent man would in the first instance undertake it. If in the course of the work it is found, that a saving can be effected, it is easy enough to extend afterwards, but if the work is under estimated, and a larger tract opened than the available funds can do justice to, there must be a resort to borrowing, by which ninety planters have been ruined for every ten that finally escaped from the toils. For my own part I would rather have 50 acres, or even 20 acres, that I could by my own resources cultivate in the best style known to the profession, than struggle with a large extent, of which I was only proprietor in name, and at the mercy of parties who might force a sale on a declining market, any day that suited them. Every planter of thirty years' standing can call to mind many instances of this kind of transaction among their own friends and acquaintances, and has had good opportunities of watching how it affected men of different characters. One would toil late and early deny himself necessaries, economize in every way possible, and sink struggling to the last. Another would fight manfully for a time, but as fate closed in about him he would give in, seek comfort and oblivion in the bottle, and sink rapidly into a drunkard and a loafer; to reside some time in a lunatic asylum, and finally die in a pauper hospital. Perhaps those who made the best of the circumstances were those who went to England, and enjoyed life, as long as their agents would honour their drafts. The collapse came very hard on those who to the very last believed themselves on the high road to fortune, and assumed matrimonial responsibilities on the strength of it. The tale of "How I Lost My

Wattie" is no fiction, but falls short of facts that have really happened, not only in one but in many instances.

Had all the planters who have been ruined by undertaking more than they could do, with the means they could command, confined their operations within the bounds of their own resources, fewer partners of agency firms would have retired with large fortunes, and Ceylon would have been accountable for fewer broken hearts and broken lives, but I suppose such things will happen, while the desire for wealth outruns the slow process of patient industry, and capitalists lend, on terms of their own making, which they well know must in nearly every case assure the ruin of the borrower, by gradually bringing into their pockets all he possesses.*

LOW-COUNTRY PLANTATIONS AND NEW PRODUCTS.

As the cultivation of Tea, Liberian Coffee, Cacao, &c. at low elevations, has widened the area of the planting enterprise, it will become necessary for such planters as go into these cultivations to apply themselves to the study of the conditions of success. I have some knowledge both of the mountain zone in the region of Arabian coffee and of the cultivation of lands from sea level up to 1000 feet of elevation, and I cannot hold out any encouragement to the hope that low country work will be cheaper than mountain cultivation. Among the waste lands of the low-country there is very little forest, and the soil of much that exists has been left by the natives as too poor for chena. The districts in which forest with soil of good quality is to be found are generally unhealthy, and sparsely populated, and though there is no want of people who would undertake their cultivation, it is just as well

* We are bound to say, however, that there is another side to this picture: there are cases in which agents having trusted planters with capital, lose it through bad or injudicious work, the security in a plantation which perhaps ought never to have been opened, being worse than useless.—COMPILERS.

to avoid them so long as tolerable soil is to be found in places where there is less risk of fever. Some of the old chenas of the Western Province have very fair soil, but they are very dirty, and the better the soil, the dirtier they are. A running fire through heavy fallen forest has generally strength enough to destroy the vitality of every plant on the land, but it is not so even with the oldest chena. The cost of felling and clearing may be from R10 to R15 per acre, but it is only when burnt off and cleared up that the real battle begins; the fire is too feeble to reach the seat of life of even small arboraceous plants, and there are many species of herbaceous plants, the seeds of which seem to remain in the soil for a long series of years, ready to avail themselves of the conditions produced by clearing the jungle. Thus it only requires a few showers to cover a cleared chena of thirty years' standing with annual or perennial herbaceous weeds, and no sooner is one species mastered than another takes its place, so that in the very first season the full equivalent of cleaning a long neglected coffee estate has to be undertaken. In one case, felling and clearing cost R10 per acre, but in seven months rooting and weeding cost R20 per acre, and still the land very far from being as clean as old forest newly burned off. Besides the original cost of clearing the land, there are several extra works on low-country as compared with mountain estates: on the former a fence is an absolute necessity, and the levelling down of white ant hills will, in most localities, be an item of some importance On the other hand, there are several advantages that the low-country estates have over the highlands: notably, in transport of supplies, and material, in the cost of buildings, in a paying market for timber, where any timber, is; in the greater number of products that may be cultivated, and probably five cents a day saved in the all-round pay of the coolies. I do not see, however, that a low-country estate can be fairly estimated to cost much less at the end of the fourth year than one on the mountains, but it is the duty of every one engaged in such an enterprise to do everything as cheaply as may be consistent with good work.

NOTE ON ESTATE ROADS.

I have always considered this a matter of importance in opening a coffee plantation. I would make a mile of road to every twenty-five to thirty acres, and, wherever possible, without incurring an expense out of proportion to the advantages to be gained, I would trace them, so that they might ultimately be made to bear carts, at least the small single bullock-boxes, most suitable for estate work. The finishing of the roads may extend over years, but, if possible, the traces should be run, and cleared, and the path formed, however slightly, before planting. If this can be done, the cost will be soon recouped, in saving the time of the coolies, on their way to work, as any one will admit who has seen a string of them in Indian file getting over half a mile of steep ground strewed with charred logs. The roads of an estate should be a system, all radiating from the site of the store, and accommodating the bungalow, so that, departing by one line, the superintendent may be able to return by another, after having seen every part of the plantation, without leaving the roads, unless he should be called on to make a closer inspection of any particular spot.

An estate on which the roads are not traced the first season is never likely to be a well roaded property. There will be always a reluctance to destroy or remove well-grounded plants of any size, and we may fairly expect, that where this work has been deferred till the coffee is in bearing the roads will be few and bad; I would therefore recommend, that, if nothing more be possible the first season, the traces should be laid and left unplanted.

I have never had to do with a place where a good system of roads could be traced on an arbitrary gradient with an instrument, unless I had been prepared (which I never was) to expend a good deal of gunpowder. Where rocks are to be dodged, and easy crossing places to be caught in rough ravines, the eye is the best instrument when the tracer has studied his ground well and made a map of it on his sensorium; he will find no serious difficulty in avoiding abrupt dips, unless the ground be too full

of boulders to be dodged cleverly, in which case he has only to satisfy himself that he has made the best of it.

NOTE ON ESTATE DRAINS.

There is no part of Ceylon not subject to deluges of rain, in which I have known above two inches fall in one hour, while the most absorbent soil cannot take in one half of that quantity. In its natural state the soil is protected by a wilderness of indigenous growth that strews the surface with fallen leaves and twigs, and it is bound by a felt of intertwined roots that retards the flow of the superfluous water, and refuses to deliver up a particle of the soil, so that such part of the rainfall as cannot be absorbed flows off as clear and pure as when it left the clouds (so far as the eye can detect). In the process of cultivation, we cut down and burn the indigenous growth, whether the result of ten years or of ten centuries of nature's dominion. We thus throw the surface open to the action of a tropical sun ; we weed out all the plants with which nature endeavours to re-clothe the land ; we dig holes and leave the loose earth on the surface : in fact all our acts of cultivation tend to facilitate the flow of the superfluous rainfall, and to supply it with disengaged soil to carry to the nearest watercourse. The first heavy rain sweeps away all the wealth of ashes resulting from our burning ; every succeeding shower too heavy to be immediately absorbed ; takes away a part of our soil, and after a longer or shorter period all our soil proper; has left us, and our cultivated plant exists, but has ceased to grow, on a rain-beaten, sun-baked subsoil, mechanically and chemically unfit for the production of any plant of economical value.

Various plans have been tried to prevent this waste of soil on inclined surfaces, such as terracing, and wash holes ; but the plan that plain practical commonsense has taken is to make surface drains at such distances apart, that they will catch the superfluous water, and carry it away, before it accumulates into a body sufficient to move the loose surface soil ; wash holes and terracing, with all their

modifications, work on the principle of retaining the superfluous rainfall till the earth is at leisure to absorb it, but there is a weak point in this way of dealing with the heavy rains of Ceylon. No one has ever made holes big enough, or embankments strong enough, to meet the requirements of the case. All precautions may be taken with satisfactory results for a long time; yet the day comes, when all is of no avail: embankments give way, holes overflow, the water gathers body and force, and rushes down the hill sweeping away every obstacle, leaving a deep trench behind it, down to the subsoil, and often far into it, all which may be the spoil of a few minutes, and thus the work and watching of years may be neutralized in an hour.

If I could retain the superfluous rainfall of one season so as to apply it to the deficiency of another, it would in some districts be a paying operation to secure that end at a considerable cost; but retaining the water on the surface till the land can absorb it is not the way to accomplish this, nor do I know of any plan within the limited expenditure of a paying cultivation, by which it can be done. The water that passes through the soil occupied by the roots of my plant, and sinks beyond them, may feed springs at a lower elevation, but it is of no service to my plant. Were there a definite quantity of ammonia, in all the rain that fell, and were that quantity proved of sufficient value to justify expensive works for retaining it in the land, good and well, but all that we know on this subject is, that there is more or less ammonia contained in a thunder shower that falls after a period of dry weather, when the soil is most absorbent; but that in the great bulk of the rain that falls in the course of the year there is hardly a trace of nitrogenous matter. I cannot therefore see any advantage to my cultivated plant in retaining more of the rainfall on my land than the soil naturally absorbs during the fall, and as I observe that the period of thorough saturation is not one of growth, but of compelled rest to the plant, I see it to be my business to convey the superfluous water, as quickly and with as little injury as possible, off

my cultivated land, which will likewise reduce the length of the time during which the growth of the plant is suspended, from the extreme dilution of its available food.

The readiest way to attain this appears to me to be surface drains: not deep wide gaping chasms at long distances apart, but six inches deep to begin with, and an incline of one in fifteen, thirty feet apart on a surface of one in ten, wider apart on more level land, and closer on steeper. The capacity of the drains, besides, must to some extent be governed by their length: drains thirty feet apart, and one hundred feet long, will collect and deliver in the main the superfluous rainfall on 3,000 feet, but if the main should be 300 feet distant from the source, the extent of surface will be 9,000 feet, and the drain must have three times the capacity at the point of delivery, unless the incline is greater: thus the capacity of the drain should increase in direct proportion to its length, or the same object may be attained by increasing the number, and reducing the distance between them.

When I name thirty feet as the distance between the drains, it must be taken as a mere arbitrary assumption: the true principle is the permeability of the soil, and one tract may be as perfectly protected from wash by drains one hundred feet apart, as another where thirty is the distance; indeed I have seen even steep land, that took in every drop of rain that fell, and that was in greater danger of being denuded of its surface soil in dry than in wet weather; of course on such land it would be mere waste of labour to make drains.

Whatever operation increases the permeability of the soil diminishes the necessity of drains. To break up and pulverize the soil before the decay of the roots is an operation that I cannot recommend, because it would be a very costly one, and I have no data to prove it a remunerative one, but I have no doubt that if within the first year from planting an alavanga were driven a foot into the ground, one foot beyond the verge of the original hole, and the earth raised to the extent of the available leverage, three or four repetitions of this operation round

each plant would loosen the soil and render it more permeable, admit a free circulation of air, while some of the surface soil would fall into the holes and rifts made in the compact mass; it will be easier for the plant to extend its roots, and it will be encouraged to throw out laterals at a greater depth than if the walls of the hole remained unbroken. This operation might be repeated from time to time, extending the area operated on round each plant, on every repetition, and thus not only rendering the soil more permeable but benefiting the plant directly. When the roots of the original forest are sufficiently decayed to render the operation comparatively easy, the whole surface may be broken up with the pronged mamotie, and from twelve to twenty bushels of lime per acre forked in according to the comparative stiffness of the soil.

I have been met with the objection, that loose soil is naturally much more easily carried off by wash than if it were an unbroken and compact surface. To those who have advanced this objection I have always replied: "Go and try: question nature, by experiment." When a heavy rainfall has only the scratchings of the karandi to deal with, it makes short work of them, but there is a fresh supply after every weeding, by which, in a few years, you get down to the *till!* having disposed of all your true soil; but if you break it up a foot deep, and leave the surface rough and cloddy, the quantity of water it will absorb is amazing, while such part of the supply as it cannot dispose of will reach the next drain, not by surface flow but by permeation.

NOTE ON MANURING.

While of late years Ceylon has been making progress in the knowledge by which suitable fertilizing substances are scientifically selected, there are probably still wide divergence of opinions, among practical planters in respect to the best mode of applying them. Since the controversy was at the hottest in 1871, it has cropped up from time to time, in the correspondence columns of the *Observer*; without bringing forward anything novel or original. There is hardly any possible way of applying manure to the coffee plant,

from tossing it under the bush and leaving it there, to depositing it in the bottom of a hole under two feet of soil, that has not found advocates, and whatever plan has been proposed, its advocate professes to be a student of nature. "Nature," says one, "never buries her fertilizers in holes, but drops them on the surface." On this it may be remarked that when we have manufactured an artificial coffee bush we have thwarted and tortured nature too much to pretend to follow her in any part of its treatment; we have made a condition of surface very different from that on which nature feeds her wild vegetable children. Our manures are much more elaborately got up than nature's, and we cannot afford to let them be baked into inertness by the sun, or washed into like condition by the rains; besides, our plant has its roots under the surface, and it is not conducive to its health and longevity to encourage the production of feeders above the natural surface. Again we are not well acquainted with the resources of nature in placing food within reach of the roots of plants entirely under her own charge, and if we were fully informed of her operations, ten to one that the conditions are so changed that we cannot apply them to the case in point. To the gentleman who tells us that nature, having furnished the coffee plant with a deep taproot, intended that it should assist in collecting the food of the plant, and therefore should have manure placed in deep pits to encourage it to throw out feeding roots, I reply: I have never questioned nature on the point, but I have observed that in all sizes of hole, in all kinds of soil, the coffee plant throws out its strongest lateral roots within six inches of the surface. What nature's intentions may be as to the uses of the taproot I know not, but I can freely attest that, the deeper it goes, the fewer, the shorter, and the more slender, are the laterals thrown out. It is in the process of chemical decomposition that any organic substance supplies plant food; the circulation of atmospheric air is the chief agent of decomposition; if therefore I bury my fertilizer with eighteen inches of earth trodden down over it, I put it where decomposition is seriously impeded; where there are few or no roots

to avail of it, and I find that, instead of drawing fresh laterals from the taproot, those that finally reach it grow from above downwards. My object in applying any fertilizer to my coffee tree is, that I may at the earliest possible date obtain an equivalent value in coffee beans, together with a fair profit on the capital invested; I therefore put my manure where there are thousands of sucking mouths gasping for it, and where the surrounding influences will tend to hasten the complete decomposition on which its value depends. If therefore I am obliged to put it in holes, I make them only nine inches deep, fill them with blended soil and manure, finished off with a surface covering of from one to two inches of well broken earth. I should, however, infinitely prefer, spreading it over the whole surface, and digging it into the soil. By this mode of application the whole region in which the roots forage, for the plants' sustenance, is rendered more accessible, any plant food already in the soil is brought under influences that hasten its solubility, while all the feeders will be equally stimulated and the reaction will be slower as the manure becomes exhausted. A friend objects, that by digging in the manure I shall destroy the greater part of the lateral roots: so be it, I reply; I have never met with the cultivated plant, that could not avail itself of manure for want of roots, and I have yet to learn that roots will be more injured by burning than branches are. If, however, the system of digging with or without manure, while the plant is still young, become an institution, the lateral roots will naturally run deeper, the stiffness and density of the soil being the sole cause of their horizontal extension, immediately under the surface; the principal laterals indeed branch off the stem close to the surface, but if the earth be broken up, and blended with the richer surface, they assume a descending angle, and retain it till they reach the hard earth that has not been stirred. I have heard that some planters have, for several years past, adopted the digging in system of manuring, with the most satisfactory results, even on old fields, and I believe that faith in the system is gaining ground among practical men. I do not know, however, if I would venture it myself on a large scale, unless in conjunction with a complete system of surface drains.

(Corrections and Notes by two other planters of experience.)

Page 1.—At foot of page for £1 read R10, and for 30s read R15. [and so on throughout the Manual.]

Page 2.—In the second line for £15 and £10 read R120 and R150; in the fourth line for £2 to £3 read R20 to R100.

Page 5.—The cost of felling and clearing has been reduced. For heavy forest in the higher districts from R18 to R20 is now given, and in the low-country from R12 to R15. In almost all cases the contractor has now to supply his own tools. In the middle of the page for £2 to £2 10s read R15 to R25.

Page 8.—Land being heavily timbered is by no means a sure indication of its being good, as witness the heavy jungles in many parts of Ambagamuwa and Yakdessa, where the soil is poor. In these jungles the Doon and other trees are often very large.

Page 9.—Coffee is now grown in dry districts up to 5,500 and even 6,000 feet.

Page 12.—Much smaller pegs are used now than formerly, and a man's task is usually 1,000 pegs per day.

Page 13.—Add :—In lining, I would suggest there ought to be a base line made first to facilitate work.'

Page 15.—It has been found that coffee under shade does not bear as well as coffee planted in the open, and, except occasionally in a very low district, shade clearings are now seldom planted.

Page 17.—In filling the holes, care should be taken that no stones and roots are put in, and the earth should be firmly tramped down, so that there may be no danger of the plant sinking into a hollow, when it would probably *die* from damp. Nursery beds should not be dug more than 6 or 8 inches deep, as the growth of the taproot should be discouraged. With a long tap root planting is more difficult, and there is always a danger of the taproot being doubled up. The seed should not be planted more than half an inch deep; indeed it should merely be covered with soil. Close planting is to be avoided, as the plants will be weakly, 3 inches by 2 is sufficiently close, and you will thereby get strong vigorous plants.

PAGE 18.—In the 20th line, after 'level it' insert:—'Pulverize &c., and then lay out in beds.' Nurseries from seedlings are not so good as from seed; as the roots of the seedlings are liable to be bent when being planted in the beds, and the plants are seldom as healthy as those raised from seed. It is a waste of seed and nursery room to sow broad-cast. It is now rarely done. The price of plants has risen to from R6 to R7·50 per 1,000. Village stumps should never be used, as they make unhealthy trees.

PAGE 23.—It is very expensive to put on coolies to break off suckers, and as a rule when done in this way it is done too seldom, and the trees are weakened, and look untidy. The usual and cheapest way is to make the weeders break the suckers off monthly as they weed.

PAGE 24.—In the 9th line, make it—'the top will sometimes die' &c. At the end of the same paragraph, add:—'Always cut off one of the top pairs of primaries to prevent any splitting of the stem.' In the 14th line from the bottom change 'necessary' into 'unnecessary.'

PAGE 28.—Hand-weeding is the rule now on most estates in the young districts. By this, wash is avoided, and the feeding rootlets of the coffee are not disturbed. When weeding is done by hand, it is more carefully and neatly done; the weeds are gathered off the ground and buried. The usual rate is R1 per acre, but it is sometimes as low as 75c. and even 50c. per acre on high estates.

PAGE 31.—The sixteenth line from the bottom, after 'sawed' add 'slopingly.'

PAGE 34.—To the second paragraph add this note:—'When coffee trees are bearing well and are likely to suffer from leaf disease, handling should be omitted.'

PAGE 33.—Pruning is now much lighter than in olden days. A heavily pruned tree is quickly attacked with leaf disease. On account of short crops, from leaf disease and bad seasons, planters are glad to have as much wood as possible on their trees. They know there is little risk of overbearing, and they get better average crops than when comparatively heavy pruning is carried out.

PAGE 35.—6th line of second paragraph, delete 'the Colombo and Kandy'; 14th line of the same, delete 'the present.' Manure, both bulky and artificial, is now applied in larger and more shallow holes than formerly, and more care is taken to mix the manure well with earth. Even artificial manure is now applied, mixed with a large quantity of earth, and in this way it is as good as bulky manure. The mode in which it is applied is as follows:—Holes are cut, either above the tree, or between four trees, 2½ feet long, two feet wide, and four or five inches deep or 2 feet by 1½ feet and the same depth. The holes should first be half or three quarter filled with earth, leaves and prunings; over this the manure (if artificial) should be put and well mixed with the earth in the hole. It is well to have separate coolies doing each work, and the coolies covering the holes should never be allowed to mix the manure with the earth, as, if the superintendent is not at hand, they will often cover the holes without mixing. Of late years digging or forking in manure and lime has become very common, and this is doubtless the best way of applying them. The ground is thereby loosened, and the rain water allowed to pass freely through. If the land has been drained there is much less wash after forking than formerly. Care must be taken in forking not to turn up the roots, else harm will follow. If properly done, the coffee will rapidly improve. Frequently the mere digging of the soil is equal to a manuring.

PAGE 36.—To the first paragraph add this note:—'In these times cattle manure does not pay, but cattle manure composts in advantageous circumstances may.'

PAGE 40.—Add this note:—'In districts with heavy rains, water holes give a temporary benefit, but generally lead to permanent injury from filling and then breaking out, or from subsidence of soil, leaving the trees on pinnacles.'

PAGE 41.—Since leaf disease began, the bearing powers of coffee have been greatly impaired, and this, together with bad seasons, has reduced the yield considerably. Estates which formerly gave eight to 10 cwt. regularly now give only from three to five cwt. per acre.

PAGE 42.—Add a foot-note after 'name' in the middle of the page :—' Occasionally there is only one round bean, known then as peaberry.'

PAGE 48.—In first line, in place of £3, make it R100 per acre; also add :—' Nothing has been allowed here for miscellaneous expenses. A little more would be required for "tools" and also for "bungalow" than is mentioned in our list.'

PAGE 67.—2nd paragraph 3rd line for 'roots' read 'roofs.'

PAGE 167.—Coffee prices, the "Economist" table can be added to as follows ;—

DATES.				1 Coffee.	6 Tea.
1873—1 January	...	...	...	171	100
1 July	...	...	...	183	92
1874—1 January	...	...	...	233	108
1 July	...	...	...	196	101
1875—1 January	...	...	...	173	100
1 July	...	...	...	179	100
1876—1 January	...	...	...	183	100
1 July	...	...	...	164	100
1877—1 January	...	...	...	178	116
1878—1 January	...	...	...	183	111
1 July	...	...	...	163	124
1879—1 January	...	...	...	143	111
1 July	...	...	...	133	132
1880—1 January	...	...	...	151	141

A MANUAL

FOR

COFFEE PLANTERS.

First catch your hare—then skin him—is the dictum of an eminent culinary authority. So to the young Planter I would say first "catch" your land—then open. *Catch* is not so expressive a word in our English as in the native idiom. In our style it implies the act of running away. Now the land will not run away. *Select* your land, so and so, is the general advice given by writers on this subject. But select is not the proper word. You may select and yet not get the land. Some one else may be before, or outbid you. *Choose* it then. No, choose will not do either, as for the above reason you may choose your land and not get it. It may even not be for sale after you have chosen. *Secure* is the better word. Well, secure and catch to the native idea are equally applicable and equally express- ive. For example, a native friend once consulted me on the subject of a quarrel he had with another man. After hearing him state his case, and seeing the difficulties surrounding it, I advised him to engage a Proctor. Natives do not often require to be advisedto do this. They do it intuitively—generally too happy to have a case in Court. Well! my friend replied, quite pleased, "then shall I *catch* a Proctor, Sir?" This word is expressive to the native for to secure, to engage, to seize. The former of these is however our proper term.

First then SECURE YOUR LAND. This may be done in a variety of ways. You may buy it from the Crown at public auction. All such sales are held periodically, at the Government Agent's Office, after being duly advertised in the Government *Gazette* and other newspapers, and are by auction. The land is put up generally at the upset price of £1 per acre, and may be knocked down at that if there be no competition. If it be bid up, it may bring—30/, £2, £3, £5, or any price to which competing bidders may

raise it. I have known land, sold in that way, bring £20 per acre. £15 and £10 are not uncommon, while £5 is frequently bid. In general, however, the average price may be set down at about from £2 to £3, covering stamps, fees and all cost. At such Government sales the practice is to pay down on the fall of hammer 10 per cent. of the purchase price, balance within a month. Or you may buy land at Fiscal's sale, when you may chance to get it very cheap: or you may buy it dear if run up. These sales are generally the property of insolvents and are unreserved: unless the mortgagee step in, and for some suitable reason get the sale postponed. In Ceylon of late years, however, such sales have in most instances been neither more nor less than a transfer to the mortgagee. Such has been the dearth of money that there has not, for cultivated land, been much competition. And it is so common for the mortgagee to buy in such property, especially if it owes him anything near its value, that other would-be buyers often keep away, believing *he* will buy, and that it will be no free sale. In this, however, they are sometimes mistaken. There are cases wherein either there is no mortgagee, or if there be, he has resolved to let it go for what it will bring, and does not attend. In such instances rare bargains may sometimes be had. I have known at such a sale an estate of 30 acres good coffee within two miles of the high road sold for £10. I have known a house in town that cost £2,000 in building, sell for £30. And I have known a coffee estate with 200 acres in cultivation, sold for £250: the roof on the store of the property being worth all the money. I have also known an estate of 180 acres sold for £250. It yielded yearly for several years about 1,000 cwt. coffee, and made it's new proprietors fortune. Cases like these are however of but rare occurrence. They are the prizes, so to speak, of Fiscals' sales. Where a sale is known to be unreserved, and where the land is in a known and approved district, it will generally bring as much at such sale as anywhere else. At Fiscal's sale the purchaser has to pay down 25 per cent. of the purchase money on the fall of the hammer. If not exceeding £50, the balance is payable in one month.

If exceeding £50 and not exceeding £200 in 2 months.
Exceeding £200 ,, ,, £500 in 3 ,,
,, £500 ,, ,, £1000 in two instalments within 3 & 6 months.
1000 in three instalments at 3, 6, & 9 months.

The Fiscal's fees, costs of survey where necessary, and advertising, amounting to probably a few pounds.

have likewise to be paid; or rather they are deducted by the Fiscal from the proceeds of sale. So that if the purchaser be an outsider (not a mortgagee) he does not have to bear these.

Besides the modes described, through the Crown, and the Fiscal; there are other means of becoming possessed of land. You may buy it from a private holder: and in doing so you will make the best bargain you can with him. In such cases from £2 to £5 may be considered the average range: the latter figure being given only if the land be either in a very choice locality, or have the advantage of a cart road to the property—or be within very easy reach of a road, a river, or a railway. Yet I have known land in private hands without such advantage, or in a doubtful locality, or when there was a great dearth of money, sell at 5s. per acre and at all rates upward. Or, again, you may lease your land from a previous holder. Temple lands, which cannot by the rules of the Buddhist religion be permanently alienated, are often let out for cultivation in this way—sometimes on a lease of 10, 15, 20, 25, 50, and up to 99 years. They cannot lease for a longer period. The rents required for such are according to agreement. I have known £1 a year paid for 50 acres: and I have known 10s. per acre per annum given. All this depends on the quality of the land, and the competition for it; or on the convenience, or the need or greed of the incumbent of the particular temple whose property it is. He it is who gets the benefit: and after him his successor. Or property may be leased from other private holders.

Having now shewn, to the beginner in coffee cultivation, how he is to acquire his land, I shall proceed to point out to him what next he ought to do, towards its conversion into a coffee plantation. And here I would guard myself against being supposed to be conveying unnecessary instruction to those of equal or greater experience than myself. My object is simply to state briefly, and in plain language, for the benefit of the novice in coffee agriculture, the whole process of this cultivation, from the felling of the first tree, to the gathering in and preparing of the crop for market. In doing this, I shall have to go over ground that has been gone over by others before. I shall have to state many things not new to experienced planters, but necessary for the information of the learner; and which I hope to do with as little bias to individual theories on the various branches of this business as a clear statement of the case will allow. Of course I shall give expression to my own opinion on all points which

are not disputed, and where opinions differ among planters of established reputation, I shall quote as far as I think necessary, such variety of opinion. If in doing so, I may, by errors of omission or commission, offend the prejudices, or run counter to the preconceived notions of others, my plea must be that I am endeavouring to inform the young and inexperienced, not the veteran Planter. Still, in doing so, I claim his indulgence should anything be overlooked which he may consider necessary to this end, and promise to give due weight to all suggestions made by experi nced practical Planters, with a view to the correction or amplification of this little manual, should a future issue of it be required. Thus far by way of explanation. Now *revenons a nos moutons.*

Felling and Clearing.—Having got his land, the young Planter should now look out for a contractor to clear it of the jungle. But why a contractor, I may be asked? Cannot he do it by daily or monthly labourers? Yes, but not so satisfactorily. *The Tamils* (Immigrants from the continent of India) who are the class which alone can be relied on for ordinary, steady, estate work, are of a more slender make than the Sinhalese, and not nearly so expert at the use of the axe and the catty or bill-hook. Hence their work in this operation is slower and much more costly than by Sinhalese. But Sinhalese have an aversion to steady labour. They will much rather take a contract. And it is better and safer as a rule for the proprietor to encourage this taste in the Sinhalese than to attempt the work himself. Even if he could procure daily labourers to do the work, he has to take the risk of the season, and the burn. If, after felling and lopping, rain falls in quantity before the felled trees are dry enough to burn off, a mess will be made. A little patch here and there will be burned. The rest merely charred; and that charring will be sufficient to prevent a running fire subsequently. He will therefore have to pile and burn, in separate heaps, all the timber that has come under the axe and the catty—*i. e.*, all the leaves and branches, everything in fact except the trunks, which must be left to decay at their leisure. Being only single sticks however and generally straight, these do not much interfere with the work of planting afterwards. To get rid of the underwood and branches is the great desideratum. And if you have, in the above contingency, to pile and burn these, the labour of cutting into pieces, carrying to the pile, stacking in heaps as large as hay-ricks, and burning, involves an expense much greater than any profit the contractor would derive by undertaking the whole work of felling, clearing

and burning; while you may, from carscity of labour or its inefficiency, lose a season, before you are able to plant the field: as your Tamil labourers are slow at this work, while Sinhalese do not care about it. They would much rather look out for fresh work at a new clearing, than even contract—fond as they are of contracts—to clear up a bad burn. And if they do undertake it, it will be at a price that generally makes the Planter regret having undertaken the risk of the burn. There are cases in exceptionally dry districts, or seasons, where this work may be done profitably by the Planter himself: but the risk is so great, that as a rule it is better for him to avoid it. As workmen, at this sort of labour, Sinhalese are proficient. Every Kandyan especially is so in a high degree: in fact he seems born with an axe or a catty in his hand, so expert is he in the use of these tools. Sinhalese generally are fond of this work: and contractors can readily be got to undertake any quantity of clearing at the rate of from £2 to £2 10s. per acre; £2 5s. may be considered the average cost by means of a contractor, of felling, lopping, burning and clearing up, so as to leave the land ready for planting. Engage your contractor then at once And you must provide him with tools, which of course he returns to you on the completion of the work. To clear one hundred acres, which we shall assume as our young Planter's first clearing, 5 dozen axes and 4 dozen bill hooks will suffice. With this stock he can start his contractor in the work of felling. Nor will other tools be required till this operation be finished, and he be ready to commence lining.

Before proceeding further, I shall describe to our young friend the process of felling and clearing—a process with which he will have no more trouble, if he act as above advised, than seeing the work performed, and paying his contractor for the job. The felling is a very simple, yet a very interesting process. Fancy fifty men, each armed with a sharp axe, taking post at the foot of a hill, every man behind his tree. At the appointed time, whack, whack, goes every axe, till a niche about half through the tree is cut on the lower side. Then each axe is plied on the upper side, a little, say half a foot above the cut on the opposite or lower side. This upper incision need not be so deep as the lower, which is on the side, to which as a rule the tree is intended to fall. The upper cut suffices if it break the skin and approach the centre by about one-fourth the thickness of the tree or even less. Tier after tier of trees is thus served in succession, till the top of the hill is reached, if not too distant, or broken

up by intervening valleys. In the latter case the hill is divided into suitable sections, and each felled in its order. Suppose the hill or the part of it thus niched to be of the form of a cone. The last tree at the top is not only nicked, but cut so far through, that it yields to the weaker, or lower side, falling with a loud noise. In its fall its extended branches catch the adjoining and neighbouring trees immediately below it, and drag them along. One tree grapples another, and the impetus given by the fall of the first bears away those lower down the hill on either side of it. They, in turn, their neighbours below them and on either side, they theirs, and so on till the whole hill-side goes down with a tremendous roar. This is but the work of a moment: and from the fall of the topmost tree to the levelling of the whole hill-side takes much less time than does this description. It is a thrilling moment: and there is something majestically grand in the wholesale crash with which the giant trees salute their mother earth. One of the oldest and most respected Planters who has now "crossed that bourne whence no traveller returns," in an Ode published some years ago under the signature of *Aliquis*, has thus graphically described this exciting scene :—

"The axe resounds on the gum trees tall,
"They stoop, rend, crackle, and crashing fall.
"See that monarch of ages, o'erlooking the glen,
"As a chieftain predominates over his men ;—
"Around and beneath him, on either hand,
"Great trees, though half severed, still motionless stand—
"Now watch for the blow which shall lay him low—
"A forest goes down in his overthrow !
"Roaring and thundering down they swing !
"Their mightiest branches splinter and ring;
"With an earthquake's dint they smite the ground,
"And down, in their fall's far-echoing sound,
"The cheer of the wood-cutters crouching around."

Thus is the forest felled. The operation of Lopping follows. Experienced Planters generally wish this work to follow close on the heels of the felling; because, while the wood is green, the branches are easier cut than after the tree has got seasoned and tough. Some require the fellers to stop felling every week : some let the contractor choose his own time : some leave the lopping till the clearing is all felled. These last do not certainly act judiciously : nor is it good for the contractor himself to leave the wood to harden ere he begins to cut, for it makes the work much harder on his men and more expensive to himself. I prefer to do the lopping every day ; either

by stopping felling at say 2 o'clock every afternoon, and insisting on each man then changing his axe for a catty; or by having a party of catty men following close upon the fellers, and not more than a day behind them. In lopping, all the branches are cut off and strewed on the ground. If only partially cut, or not well scattered, you may get a bad burn, as the limbs of a gigantic tree will not dry nearly so fast attached to the tree as separate; besides heaps of wood collect about those branchy trees and form nests for vermin and nurseries for weeds. Separate the branches therefore, and strew them about. They will then dry sufficiently in about a month; after which apply your torch at different points, and you will soon see the whole field in one glorious blaze. If your lopping has been well done, and fairly dried, there will be nothing left after the burn but charred logs and wood ashes. The former will waste away in time. The latter act as a manure as long as they remain on the ground. But if the land be steep, they are soon washed away by the heavy rains of the South-West monsoon. It would be better doubtless for the land if the burning could be dispensed with. But where the land is so heavily timbered, as it generally is in Ceylon, the work of clearing up without burning, would be too great and costly to be adopted on any large scale, although some small clearings have been done in that way to the satisfaction of the parties interested in the work. The proper time to begin to fell is about October. And felling should be finished by the end of January, or at all events not later than the 10th February. By the 12th to 15th March you should be ready to burn off. After that date, although it may sometimes be done successfully, it is never safe; as showers frequently fall about the 20th to 22nd, sometimes even earlier. If these be heavy enough to cause the dry leaves to drop from the scattered branches, and soak the logs themselves, it makes a burn difficult—sometimes impossible. And as I have already shewn when a good burn is not got, it enhances considerably the cost of the clearing. These remarks about the felling and clearing refer of course to the opening of a plantation from forest land. Sometimes, however, they are opened out of chena scrub, a small kind of jungle of different sizes and ages, which is not primitive forest, but land that has been cleared and cultivated with grain within the memory of man. As a rule, such land if not exhausted, is considerably weakened by the successive crops it has borne, and requires renovation by manure. This kind of land can be got of all ages from a year to thirty years old. After

that it may almost pass for virgin-forest—the land having rested so long and been enriched by the decaying leaves and branches without having borne crops for all that time. Even grass lands are occasionally opened, and where they are favourably situated for manuring such lands sometimes do well. They are generally uncertain, however, and always expensive, and I do not recommend the tyro in Coffee Planting to try his hand at such cultivation. There is nothing like virgin forest:—given a block of good forest land, at a suitable elevation, with a desirable lay, and a favourable exposure—not subject to be swept by wind, or inundated by water—and you have the natural conditions necessary to the formation of a good plantation. If you do not make a good estate with such favouring elements, blame yourself and not the situation. Yes, but says my young friend, "That is all very fine—you have stated a number of conditions that should be favourable. How am I to find these out?" Listen, and I will tell you.

1st.—*Good Land.* One indication of this quality, is, if it be heavily timbered. Rarely do you find tall, straight, strong trees growing on bad land. Next, mark the soil. What depth do you find of virgin mould, *i. e.*, of the decomposed vegetable matter that in course of ages has been shed by the trees, and has rotted where it fell, and remained there forming soil? In steep lands very often a great deal of what should be such mould has been washed away by the incessant rains to which Ceylon is periodically subject. In that case you need not be surprised, if you find only six inches where the forest is centuries old. If the land be flat, or only gently undulating, you may find several feet of this description. It will be a mine of wealth to you, and save the need of manure for many years to come. The other is, however, the more common way, simply because the great majority of our coffee land is situated on the slopes of steep mountains, whose altitude draws down the passing clouds, which in the rainy season wash away much of the surface soil. In the absence of such soil, however, in any great quantity, we must look to the sub-soil. A rich chocolate is my favourite, and I have generally seen the best estates where that was the body of the soil. But a deep black is also good —sometimes indeed very fine. And there are other kinds not to be despised. A free friable kind of soil, is generally a very desirable first condition, whatever be the colour. But it should not be sandy, clayey or ferruginous. If well studded with large boulders so much the better. These keep the soil

together, as well as improve it by the process of their decay. Avoid land where there is much slab-rock cropping out on the surface, however. The soil is seldom deep upon such rock, and it gradually slides away: while even before it slips, the roots of the coffee trees coming in contact with the hidden rock, cause the tree to wither and die when in its very prime.

2nd.—*Suitable elevation.* On this subject there are differences of opinion. Some like a low elevation, others prefer a high. And the feeling in favour of the one or the other is sometimes led by the kind of seasons freshest in our recollection. A course of rainy seasons makes a low district very productive, and a run is sure to be made on a locality that produces early and heavy crops. A few dry seasons in succession, while they wear out estates at a low elevation, bring life, health and vigour to estates on high altitudes. Then the run will be on these. I have known both kinds of ranges by turns run upon as described, at intervals of every few years. Speaking for myself, I prefer a medium elevation—say from 2,000 to 3,500 feet above the level of the sea. At this altitude will generally be found combined, a good climate, and large productiveness, with a fair average quality of coffee. Higher you will get keener air—more mist, heavier and more frequent rain, with a better-flavoured berry, and generally less of it. However, at high elevations, these conditions vary: especially where the district is dry. Coffee that at 4,000 feet altitude in a wet district, where the hill-tops are crested by perpetual fogs will bear but a sprinkling of crop, with a most vigorous supply of leaves, and abundance of strong branches, will at 4,500, and even sometimes up to 5,000 feet bear wonderful crops if the district be a dry one. A high and dry elevation, with fair soil, generally bears well, and a good quality.

3rd.—*Desirable lay.* For facility of working, table-land would be the most desirable: as well as because whatever is deposited in the shape of manure will remain and enrich the soil. But somehow very flat land *does not* suit the coffee tree. It retains too much moisture and does not drain itself. Very steep land on the other hand, where rain is heavy, drains itself too much. Gently undulating land is the most suitable and best adapted for the growth of coffee, and for lasting.

4th.—*Favourable exposure.* An eastern aspect is generally preferred. 1st, because it gets the morning sun; and 2nd, because it escapes the violence of the South-West monsoon. Yet a western aspect at a

medium elevation sometimes does very well: while at a low elevation I would always prefer it; and for this reason that at a low elevation the sun pours out his rays in too great force,—"from early morn to dewy eve" drying up the soil, and evaporating too soon the moisture that settles on the tree during the night. On such lands, therefore, I would rather see the sun touch them all over about eight or nine o'clock in the morning, than immediately he appears above the horizon. For high lands, however, where there is no danger of too much sun, I would always prefer the eastern exposure.

5th.—*Not devastated by wind.* Avoid a windy locality where you can. This is not always so easy however as one would imagine. The course of the wind is very deceptive. I know one estate at whose back is a large high precipice, and whose front gently declines, facing the rising sun, and at an inclination which makes a difference between the higher and the lower portions of the land, of probably one thousand feet. The precipice at its back faces the *South-West,* the violence of whose monsoon one would naturally think would break there and disperse. Not so, however. It strikes there certainly—then comes round the corner at the lower end of the estate and rushes over its surface with a fury which nothing can withstand—shaking the very house in which the manager dwells, unroofing frequently the store and other buildings, and tearing and mutilating the trees in a frightful manner. Yet to have looked at the lay, aspect, and exposure of that piece of land before it was opened into an estate, one would have thought it a most choice lot. I know another estate also in a windy district, but so apparently sheltered,—lying in a valley surrounded by high hills—that one would at once select it after a mere bird's eye view, from whatever point, as a most eligible and desirable site. It has fine soil, and grows coffee magnificently, during the interval between the monsoons. The North-East does not bother it much; but the South-West—oh havoc!—comes howling in at a gap as the lower end, and goes roaring out at another gap at the top, carrying wreck and devastation along its route—stripping the trees of every green thing, and leaving nothing but bare sticks, where was a fine healthy green field of coffee. The store, unless unusually well secured, gets unroofed: the iron sheets whirling about like birds in the air. The door of the bungalow even gets sometimes unhinged, and flung across the room, by the violence of the gale, and an amount of damage is done, which would be almost incredible to those

who have not had experience of the fierceness and destructiveness of monsoon winds in exposed situations. Wind is undoubtedly the greatest enemy of the planter. You may have a poor soil: that can be improved by manure. You may be in a wet district: seasons change and you may have a dry season after a wet, or a course of them. You may have an invasion of bug: it will go away. An incursion of rats: they will retire having left their mark. Beetle, borer, grub and all the enemies that have ever appeared in Ceylon may be got rid of or cured. But you cannot cure the wind, so "what can't be cured must be endured," *i. e.*, if you have already got a windy estate. But if not, give it a wide berth: for although, in general, estates get used to the wind, and after six or seven years, gain stamina sufficient to resist, it is not the thing for a man of small means, as I suppose the beginner to be, to tackle. Instances are not rare, however, of estates that suffered much in their infancy, even to abandonment in fright by their early owners, coming to the front at the sixth or seventh year, and bearing heavy and paying crops for many years thereafter. It is enough to know this, if you be so unfortunate as to find yourself possessed of such a property, only do not get possessed of it if you can help it. How shall I avoid it? do you ask. This is easier asked than answered, as the currents are sometimes uncertain and deceptive; but what has been will be. The seasons follow each other with the regularity of the sun. Look at the forest you have selected, or may select, walk through it, mark the bearing and inclination of the trees. If these, though tall and straight, have a leaning to one side, depend upon it the wind is hard upon them on the opposite side: or if they are short and stunted, or gnarled and distorted, you may be sure the cold biting wind has done it, for there is no part of Ceylon sufficiently elevated to prevent trees going straight and strong, but for the wind, which represses their growth, warps and twists them out of their original shape, and curtails their natural proportions. Your land may be as good as can be got, your lay may be perfection, your altitude be the most approved—but watch for this enemy. If you have neighbours whose lands adjoin yours, and have been earlier opened, this will lighten your task. Mark how or whether the wind affects them. If it does not, see if there be circumstances in their case differing from yours, such as another aspect, higher land to windward, or a sheltered position; and if none of these be at variance, you may reasonably conclude that your clearing should, all other

circumstances being equal, turn out as good as theirs. For further tests you must be left to your own sagacity and the experience of your neighbours. Instances have occurred of some of the most experienced Planters in Ceylon being deceived in their selection of forest land so far as this liability to wind and storms is concerned.

INUNDATED BY WATER.—Beware of opening too close to the side of a river liable to overflow its banks, as such overflow may destroy a fine field of coffee when in full maturity, your labour and expense in bringing it to that age being labour in vain. Beware also of opening on the slope of a mountain where rain is perpetual. This is perhaps a strong expression, but there are some mountains on which the rainfall is excessive. On such the soil soon washes away, besides causing the growth to run chiefly to wood. Be advised by your neighbours and avoid such situations.

LINING, PEGGING, HOLING AND PLANTING.—Well now, you have got your land, felled it, lopped it, burned it off and cleared it up,—at least as much of it as you wish to open at the outset. What must you do then? Your next duty will be to LINE and PEG IT, so as to be ready for holing. 1st, then let us see to the pegs. These are pieces of wood, sharpened at the points, about 2 and 2½ feet long, and say 1 inch thick at the top. They are found either on the clearing or in the jungle, whichever may be most convenient for your present operations, and are obtained by splitting up a tree into suitable sizes, having previously cut it into the lengths required. This is done with the axe and catty, and a good workman will cut 400 in a day. A good splitting wood should be chosen for this purpose, such as Keena, Malaboddy, Doong, &c. Any wood with long straight fibre will suit, of which there are many descriptions in Ceylon. A sufficient supply of these pegs having been obtained, proceed to line. This is done with a rope of about ½ inch thick. English hempen rope is the best, because it does not stretch so much as either jute or coir. Fasten pieces of rag to the rope, at suitable distances, these being decided according to the number of plants you wish to have per acre. 5 ft. x 5 ft. is perhaps the most common distance—5 ft. x 6 ft. is by many preferred, while 6 ft. x 6 ft. is not uncommon, and suits well where the soil is rich and free. The longer distances of 7 and 8 feet which were at one time approved by Planters have long since been discarded.

5 x 5	**will give about**		**1,740**	**trees to an acre.**	
5 x 6	,,	,,	**1,452**	,,	,,
6 x 6	,,	,,	**1,210**	,,	,,

shorter distances, such as $4\frac{1}{2} \times 4\frac{1}{2}$, 4×4, and even 3×3 have been tried: but the result does not seem to have encouraged many repetitions of the experiment. Either of the three distances above-quoted will be found that most suitable to the circumstances and conditions of most lands. Well, having attached pieces of rag to the rope at the distances you have resolved on planting by, fix the rope to two poles one at each end, of say 6 feet high. Employ two stout coolies to carry the rope, having first pulled it straight: one cooly marches up the hill, the other remains at the bottom; each with pole in hand now stretches the line which is fastened up the pole about half-way, or sufficiently high above the ground not to be impeded by the logs or stones strewed on the surface. Each of these two coolies is also provided with a wand, or stick, of a length suited to the breadth, the lines or rows of coffee are intended to be apart from each other—say 5 or 6 ft. The line being thus stretched, a third cooly now carrying a bundle of pegs or pickets moves up the row and drops one perpendicularly at each rag on the line. Falling vertically, it reaches the ground at the exact spot where it is intended to be placed. A fourth cooly follows with a mallet and drives in the pegs exactly where their points have touched the ground, unless where a rock or log intervenes, when he shifts that individual peg to suit the occasion. The two men holding the rope then measure off the distance to the next row with their wands, and move the line on, the other two repeating the process already described, and so on, till the field be pegged. The lines of coffee should be made to run all one way; up-hill is generally preferred, it being most easily workable, and the labourers being thus always visible to the superintendent, or overseer, in their rows. Besides, it looks neater and prettier to have the rows all leading in one direction, than to have some running up, and some obliquely, or across the face of the hill. Planters who wish to be particularly neat in this operation line across the hill also, at right angles with the previous up and down rows, so that the whole field appears to have been done in squares, the lines looking perfect each way, *i. e.*, above and across: while some are not satisfied unless they have their rows so mathematically accurate, that they run ten or more different ways: one gentleman I know, who wished to make a show field bordering a river and near a high road, made his rows to run 16 different ways. This is very pretty no doubt, and the planter who does so will take rank as a very neat and precise workman. But I had rather not be

his employer, as that sort of needless extra work costs money, while its advantages are all for the eye.

Having thus lined your field, let us proceed to the next operation, HOLING. For this purpose, you will select from the able-bodied men of your labor force as many as you require according to the quantity of land you mean to open during the season, one man to every acre is a fair allowance. If you are late of beginning and in danger of losing the season for planting, you will employ more. But if you begin early in the season, or as soon as the land is burned off, which should be by the end of March, one man to each acre will suffice to enable you to hole the clearing, allowing for broken time and casual interruptions, by the middle or end of May. If you succeed in this, you should be able to plant up your clearing by the end of July; and unless you have much broken time, through heavy rains or other cause preventing the laborers from working, you may even finish planting by the end of June; in which case you will have made a good start. An early fell, an early burn, and an early plant, are three most desirable conditions towards making an early estate. For if you lose the proper season, or get late, either in burning, and the rain set in before you can clear, or if after clearing, you lose the fine dry weather, suitable for burning, and equally suitable for lining and holing; and if you thus be thrown into the south-west monsoon with your work half done, you will most likely drag on behind the season till its close. You may have to plant at the end of the year instead of in the middle, while your planting will be followed, before the young plants have fairly made a start in growing, by the three or four dry months common at the beginning of the year. Many of the young plants will then be killed out, while many more will drag on a sickly existence till the next rains revive them; and it frequently happens that these continue feeble and seedy plants, instead of becoming healthy and vigorous trees. I have known a second season's plants when put out at the proper time, and with the first of the monsoon, completely overtake and sometimes outstrip in the race those planted at the end of the previous season, and which had to encounter all the drawbacks above mentioned.

There is another way of CLEARING, which has come into practice of late years, an old system revived. It is to PLANT UNDER SHADE, and without a burn. It is done thus:—First cut down the underwood, leaving the large forest trees standing. Let the underwood rot, which it will generally do in about a couple of months, or at least sufficiently to enable

you to plant. By this process the fallen underwood decays, adding fresh mould to the original soil, instead of burning away the surface soil as is the case with a thorough clearing on the burning-off principle. You save soil, and make it therefore by the process now described. And there is yet another way of Planting under Shade. It is thus: cut down all the trees great and small, except a sufficient number for the shade you require—say leave a tree at every 40 feet or as near that distance as the forest will admit of. Lop well the felled trees, cut them into handy lengths except the large stems, which you will leave where they fell. Lop off all branches close to the stems, and cut them up into easy sizes for shifting. Lay them in rows between the lines of coffee. You will thus shelter the coffee, while young, from the wind; and when the rows of timber decay, which they will do probably in a year or eighteen months, they will have greatly added to the soil, for by their decay will be left in their place a top-dressing of fresh virgin mould. This mode is only advisable, however, in dry and low-lying districts. In high and wet lands there is the danger of the piled timber washing out of its place and destroying the plants in its course, as well as of harbouring weeds which spring up so rapidly in a moist climate.

Still another plan of Clearing has recently been adopted in one district I know of, that of only Felling the Forest—not lopping or burning, or leaving shade. The tree lies as it falls, and its spread branches cover the ground till they join and entwine with those of the neighbouring trees—thus providing as is supposed a natural cover for the ground from the heat of the sun, and sheltering the young plants from the wind. This plan looks well in theory, and it doubtless is by far the cheapest. But to plant in rows amid the entangled branches, and to climb and hop over the mighty trunks of the fallen "monarchs of the forest" is no easy task. It will in all probability lead to a shirking of systematic work in planting out, from the difficulty of getting over the ground with the holing, as well as of placing out the plants in line. But perhaps "dibbling" is the mode of planting on this plan: and regularity of lining may not be thought necessary. This mode is yet only experimental. The result will be ascertained hereafter. Meantime it appears on the face of it to have this difficulty and this inconvenience, the difficulty of keeping the clearing clean amid so much encumbering branch wood—and the inconvenience of harbouring vermin such as rats, &c., which often prove destructive to the young plants. I have known a whole field of coffee devastated by

an incursion of rats when about eighteen months old. On the failure of certain succulent plants in the jungles, which occurs periodically, they leave their shelter in the forest and attack and sometimes over-run young clearings. Even old ones do not escape their visitation. But it is the young shoots or branches that are most acceptable to them. These they cut through to get at the pith, and the cut is sometimes so clean, that one would think it had been done with a knife. Traps are frequently set ; and watchers with sticks appointed to go regularly over the fields in rows, killing where they can the destructive vermin, the watchers' pay depending on the amount of the slaughter. In this way I have known four thousand killed on one estate in three months, and it is well worth the expense, getting rid of the vermin. Shelter for them on the land such as the mode of clearing referred to affords, will most likely encourage these destructive raids.

But I have not yet described the operation of Holing. Here it is : Provide each man with a holing mamoty or hoe, and an alavanga or spade bar. Draw a circle round the peg to the breadth you intend your holes to be. Loosen or break the ground within the circle, and remove roots and stones with the spade bar, end cut clean, and clear out the earth with the mamoty to the depth required. In ordinary land 18 inches broad and deep is considered a sufficient size. If the ground be very stiff this will be quite enough, while if it be soft and friable a foot will suffice, or even less. It has come considerably into vogue lately to make very small holes in free soil which may be 9 to 12 inches each way, and of these sometimes 100 holes will be made by each man per day. Of 18 inch holes, however, 40 per man daily is about the average task, and it is good work if they be made the full size. In very hard gravelly or clayey soils I have known only 25 per man made in a day. Some planters too are not satisfied with a hole of average size, and fix for their standard a two feet hole. In such cases 15 to 20 per man daily will be about all they can get done, which of course makes the work expensive and slow.

Dibbling, a practice which had long since been discarded, has of late been revived to a considerable extent. It is done either with the alavanga or a pointed stick, pushed into the ground to the depth of 12 or 18 inches, and wriggled about till the earth gives way. Then the plant is put in and the earth closed around. Another and no doubt a better mode is to make first the centre hole with the alavanga or stick, then to make around it a circle of similar holes,

working the alavanga or stick about till the earth is well loosened and one hole broken into the others in

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where the soil is free, a loosened surface equal in size to the common hole. Few soils in Ceylon, however, are so free as to make this a safe or desirable process. Where the soil is very free, it is doubtless a very cheap mode of planting. But unless the soil *be* very free and soft, not only in itself, but clear also of roots and stones, this system is one not to be commended. In fact, in most Ceylon soils a good hole is necessary to the making of a good estate. Having made your hole, scrape in the surface soil in its immediate neighbourhood for two or three inches deep, and one to two feet around. This being generally virgin mould is the best of the soil. It feeds well the young rootlets, and aids the plant in making its start, much better than the soil which came out of the bottom of the hole would do : and is besides permanently retained, without the risk which it would run on the surface of being washed away. The hole thus filled should be levelled at the top, and freed from sticks, stones, roots, &c. The cooly who is to Plant may then, either with a mamoty or with the hand, make an opening into the loose earth in the centre of the hole, deep and broad enough to admit the roots of the plant. The tap or perpendicular root should not be allowed to be bent, twisted, or broken, in this process. It should go down straight as the stem. The lateral roots too should be spread out as they grew. They will thus sooner take a start in their new bed than if pushed in carelessly, or in a heap, and left to right themselves afterwards. Then cover over the earth and press it down firmly, around the stem, so firmly that a gentle pull would not raise it. This is necessary to protect it from the frequent heavy wash and wind so common on our hills during both monsoons.

How are the Plants got? is a question that will naturally suggest itself to the learner here. Every careful and considerate planter will lay out his Nursery immediately he has secured his land, or as soon after as the weather will permit. This is done by clearing one or two acres of ground on a gentle incline in the heart of the forest. Dig it to the depth of a foot, or, if the soil be very free, the depth of a mamoty will do, lay it out in beds, just as if you were sowing peas, leaving space to walk between, five feet broad is enough, and will admit of the centre of

the bed being reached from each side. A long bed is preferable, as it will contain a greater number of plants than a short one, and the ground will not lose so much by cross paths between the beds. But this may be adapted to the nature and size of the ground selected for the purpose. A flat is often prepared,—especially if near water, as a nursery should always be in dry districts, or when planted just before the approach of our dry season,—so that in a run of dry weather it might be watered. In a very moist climate, however, it is not so important that a stream should be near, as the fall of rain in such climate generally suffices. In such too, I would prefer a gentle undulating piece of ground to a flat, as it drains itself naturally. In making a nursery where there is the least incline in the ground, run a deep drain across the top to prevent wash damaging the young plants. Having laid out your nursery in beds, pulverize and smooth the surface earth, free it from lumps and stones, and level it. Then take a line with a peg at each end and divide the bed into rows, about six inches apart; a man follows the lines with a bag of seed and dibbles it in like peas, or makes a groove along the length of the rope about 1 to 2 inches deep, and places the seed, like peas, about 1 inch apart. Being planted so closely they grow up thick and support each other—leaving no room for the weeds to grow in the planted lines, while the 6 inches space between admits of the beds being weeded as required. The seed is coffee in parchment just taken from the pulper, without having been dried in the sun. Old dry cherry coffee is sometimes used also; but the undried parchment, before its growth is injnred by the drying process, sprcuts most readily, and is therefore generally preferred.

Some planters prefer making their nursery of Seedlings, *i.e.* of the young plants which spring up around the old coffee trees after crop,—the result of berries fallen, frequently from the violence of the wind or rain about the time they are ripe, and sometimes from the estate being too short-handed to admit of its being gone over by the pickers as fast as the crop ripens, but always to a greater or less extent unavoidable. The same process of preparing beds for these is requisite as that used for seed: and the plants are dibbled in the same way. In a moist climate or season these come on much faster than seed: but in dry weather they are apt to be very much tried—before they get fairly acclimatized to their new bed– unsheltered by the parent tree. Again a Nursery is sometimes sown broad-cast, *i.e.*, where the soil is very free and contains sufficient moisture to

germinate the seed. Under such circumstances where it succeeds, and it often does succeed, it is the cheapest kind of nursery. Care should be taken, however, to cover the seedlings with some light shade, when a course of dry hot weather sets in, before they have acquired sufficient strength to withstand the grilling effects of a tropical sun. Where the planter has had no time to make a nursery before his planting began, or where from any cause he has not a nursery of his own, he may purchase from a neighbour, if he have one, who can spare plants, at about 8s. to 10s. per 1,000 plants fit for putting out, or he may buy from the villages. In this last case they are generally planted out as stumps, *i.e.*, the top is cut off and the roots trimmed in both tap and lateral, so that they are much more easily planted out than nursery plants. In dry weather too they are more hardy, and will endure a long course of it without being injured; on the other hand they are slower of growth. But after they have fairly made a start they grow very fast, frequently overtaking nursery plants put out at the same time. As a rule, however, given an ordinarily favourable season, I would always prefer nursery plants to stumps: while, if the weather were doubtful or dry, I would put out stumps. A course of wet weather after planting will often kill out stumps, while it is the very life of plants. The reason village plants are generally stumped before being planted out is, because, having been reared in the shade, they are apt to sicken and die when exposed to the full blaze of the sun. They are besides of all ages; and old ones do not grow so readily as the young. Many of the old too are black-hearted, or injured in the roots, which the stumping discovers, enabling the planter to discard such as are diseased. Whenever practicable, however, I recommend the planter to have his own nursery. It is much cheaper than buying plants. It makes him independent of foreign aid, and it ensures him a supply of sound and healthy plants by the time he wants them.

Well, we have now Felled our Land, Cleared it in the way we have approved, Planted it out with Nursery or Village Plants or Stumps,—what, asks the tyro, are we to do next? Your heavy work is now over, your field is clear, and you can look about you for sites of Permanent Buildings. We shall suppose that up to this time you have been residing either with a neighbour or in a temporary hut erected on the outskirts of your land, far enough removed from your clearing to avoid the risk of its being carried away by your fire at the burning. Such *has* happened occasionally, from the want of a little forethought on

the part of those who were above asking advice or seeking counsel from their more experienced brethren. You will want a Bungalow for yourself, and one or more sets of Lines for your laborers.

The Bungalow is a matter so entirely of taste and pocket, that it is hardly necessary to describe it here. If you want a common mud and thatch house, any Kandyan will undertake to build you one very cheap. If you want a more stylish article, you had better engage a builder, get a plan, specifications and estimate for the sort of house you want, and you will have one in course of time. One man may be satisfied with a building of wattle and daub, consisting of two small rooms and cook-house with common doors and shutters and mud floor, which may cost him £20. Another may think the cheapest place he could live in would be one a little bigger, with shingled roof, glass windows, good doors and wooden floor, and some additional out-houses, which might cost him £50. Another may find £500 his lowest figure; while I have known several planters' bungalows cost £2,000 each. It is entirely a matter of taste and money. My plan would always be to build a suitable house according to my means, of a sufficient size, and at a moderate cost, which could be enlarged or replaced when the plantation had given some return; from the amount of which I could be guided as to the size and style of my future habitation. For work-a-day men, however, who do not wish to cultivate luxurious habits, a house to begin with suitable for a bachelor and sufficiently commodious could be built for about £50, and for a family at all rates according to quality from £100 to £200.

Lines in like manner must depend upon the quality for their cost. Some planters prefer these being permanent, brick and tile, or stone and lime buildings. These, where the materials are handy, are the most economical in the long run. But their first cost is more than many planters care to incur. For the man of money he may as well have all his buildings permanent from the first, but for the man of small means, he can afford to wait for fine buildings and be satisfied at first with those of a more ordinary construction. Wattle and daub lines with thatched roof can be built in rooms capable of holding 10 people each, at from £1 to £2 per room, according to the district they are in. Lines of stone pillars, pointed with lime, mud interstices, and shingled roof, may cost £5 per room; while proper pucka buildings, *i.e.*, all stone and lime, or brick and lime with tiled roof, may cost all rates up to £10 per room according to the facility or otherwise of procuring the materials.

And there will be no difficulty in getting these built of the kind you require, either on contract or by daily labor.

Having now got a Bungalow for yourself and Lines for your laborers, you have leisure to look about you to see what is the next necessary operation that should engage your attention. ROADS will strike you as very necessary for the convenient working of the plantation. Some people make these before planting at all, and doubtless where labor is in sufficient abundance to admit of this being done without your being thrown behind with the more important work of planting, or if you are sure to be able to complete your planting within proper season, after having done your roading, by all means road first. It will save you cutting a number of holes, which from the course of your road you have afterwards to destroy, as well as save many plants from being buried during the progress of the road. But this is not often possible. Seldom has a planter at the outset the command of labor sufficient to do such works as roading and draining, but when he has it is well to do both. When pressed however for time to do his planting before the season passes away, we generally find the planter using the energy of every man he has to plant up his land, leaving every other work to stand over till that be accomplished. In the present case we have finished our planting, and now for *the Road.* Begin at the bottom of the hill, set your level to a gradient of 1 foot in 10, and follow it up till you reach the top of the clearing. This will be a very good working gradient, and will suit the lay of most lands. It will also divide your estate sufficiently, and make working easy. Should you intend it ultimately to be a cart road, then let 1 in 20 be your gradient. Drive in pegs as you move on the level, and cut from the lower side, to the breadth you intend your road to be. For ordinary estate purposes, short of cartage, four feet in the solid will be a very good size, even for tavalam cattle, or pack bullocks. But if you want to be very economical at the commencement, a two feet road can be made to answer your requirements for a good while, widening it as you find necessary or expedient.

Your work is now so far advanced that you will be able to take it easy for a while. You may sit down and see your plants grow. The only work you will have for some two years from this time will be to look after your WEEDERS, and see that they keep the estate clean. This you will find necessary whether you weed by daily labor or by contract, and it is by no means the least important part of the plant-

er's operations: for the difference between weeding an estate occasionally or whenever the weeds have attained to the flowering stage, and keeping out the weeds altogether, is that between a profit and a loss. Keep down the weeds say some. *Keep out* the weeds is more valuable advice, and much more economical work. You may keep them down by regular monthly weeding, so that at one part of each month few weeds are visible. But this may be at a cost of 30s. to 40s., and even 50s. to 60s. per acre per annum, while by *keeping out* the weeds from the first you should be able to weed for 1s. 6d. per acre, sometimes less each weeding, or say 18s. per annum, sometimes 15s., and I have even heard of 10s. sufficing for the year. But say 20s. as an average, and you will save at least 20s. or 30s. more by this system. That, on an estate of 200 acres will be, at 20s., £200; at 30s., £300, and so on. Nor need you wait till your land is planted before putting on a weeding force. Immediately your clearing is burned off, and before weeds have time to take root, commence weeding: and continue it monthly afterwards. The small jungle which first springs up, if the land have been forest, will soon give way; three or four weedings or at most half-a-dozen generally eradicate this description of weed. It is not the worst kind, as it does not seed, and is easily pulled up by the root. If left, however, seeding weeds are apt to spring up, under its concealment, which give a world of trouble to get rid of. Those seeding weeds, especially one called the Hulantala, and another called the Spanish Needle,—but notably the former,—are the planter's bane. Several grasses also, and some creeping weeds give much trouble to eradicate. To keep them out therefore is, or ought to be, the object of every prudent planter. A few regular weedings will make your field quite clean, and going over it once a month will keep it so. Once arrived at that stage, you will want but a very small labor force for some time. One man will suffice to keep clean 10 acres, whereas in a weedy estate one to every 3 or 4 acres is about the force required. You can also weed by hand on a clean estate, which saves your soil from being wasted, and washed away, the result of continual hacking at it with the hoe. In every way therefore it is cheap, thrifty, and profitable to keep an estate clean from the commencement. Having arranged to give this work proper attention, you will now ask, what next? When the plants are a few months old, it will be well to keep a small party of searchers going over the fields occasionally, to pluck off *suckers* and any *irregular branches* which make their appearance about

this time. *Suckers* are upright shoots that spring from the stem, generally below one of the arms or lateral branches, and draw sustenance from the tree, without giving back crop in return, unless allowed to grow so large as to send out branches and blossom of their own. This is however unwise and exhausting, and is never tolerated on a well-managed plantation. *Irregular branches* are those that point towards the stem, or across the tree in a different way from their normal direction. By allowing these, the natural branches get covered up, are excluded from light and air, do not bear, but grow matted and form the commencement of a neglected and irregular tree, frequently called "a crow's nest." This is easily checked while young, and if done then the tree will be nicely kept in condition, and easily pruned when it requires pruning. The natural tendency of a coffee tree is to throw out its branches as nearly as possible at right angles, and, with fair treatment, no tree is more symmetrical, or regular, or beautiful.

Draining, like *Roading*, will best be done before the Planting. But this in most cases must depend on the purse of the proprietor and his supply of labor. If both abound it will be economy to finish all necessary drains and roads before planting. For the reasons given under the heading *Roads*, howver, this is often impracticable, and where it is so it will be wise to defer the making of drains till the plants are about 18 months old. If undertaken immediately after the plants are put out, or even within 6 months, a great many fine healthy and promising plants will unavoidably be destroyed by the loose earth that is taken out of the drains burying entirely the row nearest the lower side of the drain, sometimes even a couple of rows, especially if the land be steep; whereas, if the plants have got up to 18 inches or upwards in height, the falling earth may cover up the lower part of the stem, but the top of the plant will shew, and the earth can be cleared away. 15 inches broad and deep will make a very good drain. But if the land be steep I would prefer 18 inches: and drains should be traced at a gradient of about 1 in 12 to 1 in 16 according to the nature of the ground; and about 50 feet apart. If the angle be much easier, the drains will fill up and give trouble to keep clear: while if much steeper they will cut up the land.

Topping will also be necessary about this time. It should be carefully and judiciously performed. This operation consists in cutting off the top of the tree at the height which you intend it not to exceed. 3 feet is a very good average height; where the soil is rich, however, I would allow 3½ feet; on the other

hand where the soil is poor, or the spot blown, I would be content with $2\frac{1}{2}$, 2, or even $1\frac{1}{2}$ feet according to circumstancs. In strong soil where the trees do not suffer from wind, a $3\frac{1}{2}$ feet shrub will yield as much crop as it can safely carry: and it is a much handier size than if it were allowed to grow taller. The cutting off the top prevents the tree attaining a greater height. But it should not be cut till the brown bark shew. If cut while green, the top will die back to the brown wood, and you will lose one or two pairs of branches, or more.

Staking should be begun about March, so as to be completed before the setting-in of the south-west monsoon about the 1st of June. It is seldom necessary till the second year after planting: as, if the plants have been put out between June and December, they will scarcely be tall enough to feel the wind by the following June, for they will only probably be 9 to 12 inches high: and at that age they will bend to the breeze. When, however, they get to the height of 18 inches or 2 feet, if in an exposed situation, the wind takes a strong hold, and twists and wriggles about the tree to such an extent that it often dies out: or if it do not immediately it has frequently a sickly struggle for a long time, till it make new roots and they take a firm hold of the ground. Often the twisting and whirling about of the tree leaves a hole around its stem, which if not noticed and pressed around with the foot so as to replace the forced back earth, the monsoon rains fill the hole and rot the roots. The tree then withers and dies. It is important therefore to go frequently over the clearing and inspect all the blown trees; for even staked trees frequently suffer in the way above described, while, if they were left unstaked, they would suffer and perish in much greater number. Some districts and some estates however do not suffer from wind at all: and where this is the fortunate case staking is necessary. The mode of staking is as tollows:—Take a picket similar to that you have used to peg out the ground for planting—like it too, pointed, but a little longer. If the tree be 2 feet or more in height, 3 to 4 feet is a very common and very suitable size; but you will require that height, as you will lose from 6 inches to 1 foot under ground, while the angle at which you place it will use up another 6 inches. It should be driven in slantingly across the tree like an X, and with its head facing the point whence the wind blows. Tie it about half way up to the peg with a loose loop or noose at the end adjoining the stem, to admit of a little pay without chafing the tree; and coir rope

or rag, or any soft substance may be used for the purpose. I have known plantain fibre used very successfully. It is soft and strong, and abounds in a wild state in many jungles, chiefly in the low country however.

SUPPLYING should be carried out whenever you have seasonable weather after the first planting, until all vacancies have been filled up, and the plants are growing. You may sometimes require two or three supplyings before all the plants take root, especially in dry or uncertain seasons. In a moist climate or season, supplies succeed much better than in dry weather. But whether the seasons be wet, dry, or variable, this operation should be persevered in till your field be complete, for nothing offends the eye more than a patchy field—or a field with clumps of good coffee interspersed with blanks. It is besides not economical, as you have to weed and keep clean the vacant spaces which give you no return, as regularly and frequently as the planted portion. Strong, healthy plants or stumps should be selected for supplies.

HANDLING or searching, systematically, is a work that from this time onward, till the trees be in crop, will claim your attention. This consists in taking off suckers, gormandisers, cross branches and extra or unnecessary shoots—especially all that grow within a span of the stem. If this be regularly done while the tree is young, or before it come into bearing, the work of pruning afterwards will be comparatively easy, as you will have a regular symmetrical tree to work upon, and will not be driven to the necessity of cutting and training it back into shape, for it will never have left the shape which nature intended it to have. The coffee tree has a strong tendency to be exuberant in the production of wood at this early stage of its existence; and if neglected then, and allowed to grow as it likes, it will force out shoots at every eye far in excess of what is necessary to produce crop, and such superfluous production will reduce the bearing power of the tree.

BUILDINGS.—Early in the 3rd year you should select sites for your store and pulping-house. These are frequently built under one roof; but, whether in one building or detached, both will be equally required this season. No time, therefore, should be lost in their erection. Like bungalow and lines, they may be made either of wattle-and-daub, if intended only for a crop or two, or if permanent they may be of wood, brick, or stone, and tiled, shingled or iron roofed, and of a size and style dependent on the purse and taste of the proprietor. If he be wealthy, he will most likely desire to have his buildings complete

and permanent at once; and capacious enough to cure and store all the crop his estate will yield when fully opened up. If on the other hand his means are limited, he will prefer either a cheap and small store for a crop or two, or he will make the building permanent but small at first, and capable of extension as the productiveness of the plantation may demand. Supposing you intend to open up to 200 acres, but have begun with 100, a store commodious enough for your first and probably your second crop also, 40 ft. × 20 with a loft, would suffice, and a pulping-house 20 ft. × 10 with a cherry loft and pulper floor. These could be built of sawn timber and iron-roofed for about £200. If you build with a view to extension, however, a better size would be 50 ft. × 30, taking off 10 feet at the end for your pulping-house. Next year you could extend this building to 80 feet or even 100, which would be as large as the estate would ever require. Extended thus, the outlay on store and pulping-house should not exceed from £400 to £500. If stone or brick and lime are the materials used, however, they will cost double this amount. But, as before said, this so greatly depends on purse and taste, that it is with reluctance I name cost price at all in connection with buildings. The figures named, however, will suffice for those of a mediocre quality. Or you may build a store of jungle wood, with sawn timber floors and shingled roof, which will do for two or three crops, for about £100, inclusive of pulping-house. I have built one of this description 70 ft × 20 with two floors, capable of storing a crop of 400 cwt., for £70. This was in a dry district, however. In a wet one large accommodation would be necessary. *Buildings*, especially stores, are works on which much money is often unnecessarily wasted. Houses, larger, stronger, more capacious, and of masonry more massive, than the property will ever require are frequently built at a ruinous cost to the proprietor. Partly this is the result of inexperience; but sometimes also it arises from the manager's desire to eclipse his neighbours in the character of his buildings. Many proprietors too indulge in this extravagance under the belief that it is economy to have all the buildings their estate will require made complete and permanent at the outset. It will save the construction of temporary buildings, the cost of which they consider money wasted. But I shall shew that this is an error; and that it is neither expedient nor economical to erect permanent buildings at the commencement of an estate. It is inexpedient because you have many things to learn, such as how the wind affects the spot upon which you wish to place your

bungalow, how the sun strikes on the spot on which you would build your store, and how both sites are off for a constant supply of water. Springs often dry up. And various other matters which you will learn by experience will be useful and available before you come to require your permanent buildings. Neither is it economical, because the interest on the outlay on permanent buildings before they are necessary will exceed the cost of the temporary erections, thus:—Supposing you estimate that the permanent building you intend to erect on the estate will involve an expenditure of £1,200, a modest enough amount for an estate which is to be opened up to 200 acres. I will guarantee to put up all needful buildings, comfortable enough and sufficient to last for the first four years, for £200. You will thus save interest on £1,000 for that period, which at 10 per cent will be £400. So that you will be a gainer of £200 after paying the cost of your temporary erections. Even supposing that the store is only built at the end of the second year, and that it costs £500, although on it you only save two years' interest, you will still be a gainer of £100 by having adopted the principle of temporary buildings at the outset. But temporary buildings of the kind above contemplated would last five years instead of four, so that there would still be a profit of £200 to £300 by the transaction.

WEEDING is the planter's bane. It is his ceaseless, watchful, constant care, his never-ending toil. It begins immediately his clearing is burned off; and he gets no rest from the constant weed, weed, weed, as long as it is an estate; for weeds will grow, and quickly too, in such a forcing climate as ours. On a field of coffee every green thing is a weed, except the coffee tree. All feed on the same land, are nourished by the same atmosphere, and exhaust those properties of the soil which combine to produce the coffee bean. Some weeds in fact—such as the Hulantala, one of the most generative as well as destructive of weeds—contain all the elements required by the coffee tree and in nearly the same proportions. Now it is very evident that if they extract from the soil those substances necessary for the formation of ccftee, the coffee tree must lose what the weeds gain. It is true all weeds are not equally exhaustive. But all take nourishment from the soil—whether it be a flowering weed whose seed in millions overspread the ground, reproducing its kind till the field is covered with a greensward like a carpet, or whether it be a root-spreading weed, a jungle plant, or grass, all are weeds, and ought to be eradicated. All are not, however, equally difficult to be got rid of. If you com-

mence weeding, immediately after you have burned off, which is the plan I would always recommend, there will be only a weed here and there—easily picked up: and you will have no difficulty in getting this done either by contract or daily labor at a cost not exceeding 1/6 per acre; and if you continue this practice monthly, you will not, over the year, have to spend more than 18s, which amount per acre per annum will weed the estate afterwards. If however you have been unable to put on a force to weed immediately after you burn, a rush of weeds will soon cover the ground. If there be no weedy estate adjoining you, and your estate has been opened out of forest, the first cover of weeds will be chiefly jungle stuff, which does not flower and will be easily pulled up at a cost for the first weeding of probably 5s per acre. If you follow up this weeding quickly with another, and another you will reduce it in two or three weedings to the normal figure. Then continue weeding monthly, even if you can only see a weed here and there. Go over the ground regularly, and you will prevent their spread, and do your weeding cheap. It is a very false economy, as most old planters now know to their cost, to leave over your weeding for another month; because you hardly see a weed. Doubtless there are a few, although you have not discovered them: and one flowering weed will be a nursery for your estate, and will soon cover the fields with myriads of its progeny. If you have been unfortunate enough to get into this state, and can spare the men and the money to make your estate again clean, you can do so by going over it twice a month for the first three months or so, then weeding it once a month afterwards. It may be again rendered clean in about two years; this will be costly, but it will well repay itself. I have said in another place that the cost of weeding ranges from £1 to £3 per acre. You will see therefore what you will save if you can do it on the £1 scale. Even less it is sometimes done for, as I have also shewn elsewhere. If your estate be weedy, and you, having given up all idea of making it clean, are satisfied with six or eight weedings a year, you may keep it clean enough to prevent it doing much harm to the coffee. In this way you will have perhaps one expensive weeding after crop, which may cost you 5s or 6s per acre: and afterwards you may do it for 4s 6d to 4s, or even 3s 6d according to your elevation, soil, climate, &c., while if you can do it ten or twelve times you may do it for from 2s 6d to 3s 6d per acre each time, according to the same circumstances. The tools you will use for this work will be the mamoty or hoe, if your estate be weedy.

If clean or monthly weeded, you will use the scraper, or as the coolies called it *karandi* (a spoon). There are various kinds of this instrument :—1st, The piece of hoop bent at one end like the letter *l* and at the other pointed. Then there is the same hoop without the point, fastened on to the end of a stick about three feet long, which the coolies work standing. There are also varieties of pointed diggers, and scrapers of various forms, used by the laborers in a sitting posture, suitable for taking out single weeds here and there. Each have their recommendations, to explain which, space in this small work cannot be afforded. The tyro will soon however learn for himself the tool best suited to his particular circumstances, and will adopt it. Again there is the *hand-weeding* system, whereby everything is pulled up by the hand—no pointed instrument being allowed. And where this is practicable it is doubtless the best and most profitable system, for, as most of our plantations are hilly, and from the nature of the ground subject to be burned by the sun, and washed by the rain, whereby much valuable earth is wasted, it is well to disturb the soil as little as possible.

Pruning is perhaps the most important operation of the planter. It requires his careful and judicious supervision : for, while nothing is simpler than to cut off 2 or 3 cwt. per acre, nothing is more difficult than sticking them on. Many planters, from a laudable desire to have an ornate tree, cut, hack, strip and lop off everything that militates against the regularity of its proportions ; but the prudent planter will study to prefer crop to symmetry. Where a plantation has been carefully tended in its earlier years ; where it has been properly, and regularly handled, it will not, when it arrives at maturity, give much trouble in trimming ; and except the cutting off dead wood, or wood that has borne (for the same wood never bears twice) removing suckers, cross branches, and exuberant shoots from the centre and along the primaries, in the way hereafter explained, there will be very little to do in that line for some time. It is after an estate has borne two or three crops—after it has, either from over-cutting or from want of timely handling, been allowed to get matted, umbrella-topped, or choked up by superfluous wood, that the real difficulty of pruning begins. It is now too that the planter's skill and science are called into play. As to the best time and mode of dealing with a field so circumstanced, opinions differ, even among practical men who have made the business their study. For instance, Mr. James Taylor, a planter of considerable experience, thinks pruning should not be commenced

till after the blossom has set; while Mr. W. Sabonadière, another experienced planter, in his work on Coffee Planting, differs entirely from Mr. Taylor, and thinks pruning should be completed before the blossom comes out. In this he is borne out by many other planters of as great or greater experience. In support of Mr. Sabonadière's position a great deal can be said:—1st, By pruning early the tree is at once relieved of much dead and useless wood that has served its purpose, but is now an encumbrance. 2nd, By relieving it of such impedimental matter now when faint as it were from the loss of blood—weak from the drain on its vitality by the crop it has given, the tree looks seedy and suffering,—you bring into full play all its latent juices, for the support of those boughs which are worth retaining, as well as for the creation of new wood against next year's crop. 3rdly, The spring of the year is the spring time of all vegetable life, and in no plant is this more marked than in the coffee tree. 4th, It is the most convenient time, as your crop force is still available, and the most practised of them can be set to this work, before their usual exodus to their native country. 5th (and this is a point which does not appear to have been noticed by the several experienced planters who replied to Mr. Taylor). Although as a rule much wood is not produced capable of bearing the same year, ends of branches stretch out which frequently give a considerable sprinkling of crop, while not a few strong and healthy secondaries mature sufficiently to give fruit.

Mr. Taylor's theory has however this advantage, that you see where your crop is to be before you begin to prune, and need not deprive yourself of any part of it by cutting off bearing branches. But this is inconsistent with preserving the proper form of the tree; for when every eye has blossomed you will often lack the courage to apply the knife to a most irregular branch, even though next year its retention will cause you a much greater sacrifice. Under all the circumstances therefore surely Mr. Sabonadière's plan should carry off the palm; seeing it is supprted by so many cogent reasons, besides being the system first sketched out by that chief of the writers on Coffee Planting, "*Laborie,*" and pursued successfully by him, and subsequently by many practical agriculturalists in Ceylon as experienced as himself. On another point in the practice of pruning does Mr. Taylor differ from Mr. Sabonadière, and many orther planters whose opinions are entitled to great weight. It is as regards the long hanging-down primaries, generally denominated whips—*i. e.*, branches which in the centre have few

leaves and fewer berries, but at the ends shew vitality and fruit. To those who are fond of horizontal lateral branches and whose eyes turn away from a hanging-down bough, doubtless those whips are an eyesore: and it is a common remark among such persons, "What 's the use of all these whips, with only a few yellow leaves at the end? Cut them off, why cumber they the tree?" Not so fast, my friend. It is wonderful what these ends of branches sometimes bear. Although immediately after crop they look seedy and withering, just watch them after the pruning has divested the tree of its useless encumbrances, watch them on the first shower thereafter, and you will find that the leaves get gradually green,—then more numerous,—then blossom shews,—and by crop-time you see dangling towards the ground a series of fine healthy bearing boughs, loaded with considerable clusters of ripening cherry. Just the other day I walked over an estate of this sort at an altitude of from three to four thousand feet above the sea level; and a prettier show I have seldom seen. Out of a crop ranging from 8 to 12 cwts. an acre on the parts in bearing, I should think quite half was produced by those whip ends. And would any proprietor, who sees what these can do, be insane enough to cut them off? On this point therefore I agree with Mr. Taylor. Another dogma that obtains favor among many planters requires to be received *cum grano*. It is, "Never cut a primary"—on this head I would add with "W.", "till it requires it." A primary may be dead at the end, or it may be broken. In either case it will never rally, then why retain a useless encumbrance? Relieve the tree at once by cutting off such. In the same way should be served any other part of the tree that has been injured, wounded, or has died from disease, attacks of insects, or exhaustion: with "Laborie," I would say:—"If a head be spoiled it must be sawed, If "any of the superabundant branches have been left "through neglect, these must be cut off. If a bough "has been broken by accident, and if any branches "have become spent and withered from too great a load "of fruit, these must be pruned. In short everything "that is defective must be completely taken away, "but without retrenching anything else." Thus much as regards the general outline of pruning. But the learner will want something more. He will want me to come to particulars. This I shall presently do. But I must premise my remarks by saying that where such a wide field is open for discussion, and where varying systems differ as do men's minds, it would never do to occupy space in a small handbook like this, discussing the conflicting theories that prevail

among planters on the several branches of this important operation. I shall content myself therefore with describing how I would prune a coffee tree. For this purpose I shall assume a tree as a type of a field that has had moderately fair and not very bad treatment, and shall suppose the season to be after crop. I would commence by cutting off the dead wood, as far back as the first living eye. Then I would pluck off the suckers; then thin out the centre by divesting it of every shoot a span back from the stem. This is necessary to give the tree ventilation, and to let the sun penetrate through it to the earth, thus warming into activity its dormant elements: preventing the accumulation of moss, and rendering the tree manageable to both searchers and pickers. I further believe that, by well opening out the centre, the tree is much less liable to be attacked by bug than when close and impenetrable. I would then take off all cross branches, *i. e.*, those which either from accident, injury, wind or any other cause take a different course from that which nature intended them to have. If left to grow in the course they have chosen, they either cover up other branches and prevent them from bearing, or grow into the centre, choking it up, and retarding free circulation. Be bold therefore, and though it be a good branch pluck it off. If you find more than one shoot at each eye on the lateral boughs, pluck it or them off, leaving only on the quantity nature intended the tree to have. I now come to what I consider the most important step in the pruning of the tree—the secondaries—because you are to deal with what is to give a great part of your next year's crop. A writer whom I have already quoted, "W.", a well-known planter of great experience (but, having written under cypher, I have no right to unveil his incognito), in an able paper on pruning which he addressed some year's ago to the Planters' Association, describes this operation and that of handling generally, so well, that I take the liberty of giving his directions in his own words:—"To ensure a regular and strong tree then, "handling must be resorted to early. In doing so take "off all the branches that are within 6 inches of the "stem, and make an opening of one foot in circum-"ference in the centre of the tree. This, besides "strengthening the primaries, will admit the sun and "air to penetrate, both of which are beneficial to the "growth of the tree, as well as the ripening of crop. "*Next run along the primaries and single out the* "*secondaries, leaving no pairs, but one secondary only* "*at each joint, on either side of the primary alternately.* "This I know is thought very unnecessary by a large "class of planters, but if they will only study the tree

"itself, they will find that although nature throws "out the secondaries in pairs, almost invariably one is "stronger than the other; and by a little care the strong "ones can be left and the weak ones taken off. It is "better to look to the strength of the wood than the "quantity of it. As secondaries left on too near the stem "tend to weaken the primaries, so do they when left in "pairs, cramping as it were that expansion, which takes "place under the treatment I advise. To those who "wish to leave everything on for the virgin-crop, I "would say that I have known coffee trained under "the above system give a virgin crop of seven cwts. "per acre." This is a very good description of the whole process of handling out the tree: but the portion for which I mainly quoted it, and which fits in to my previous directions, is that which I have italicized. On this point, the late Mr. R. D. Gerard, who was a leading planter in his day, used to direct his superintendents "*to leave not more than five secondaries on each primary.*" That number he considered as many as the tree could safely carry, and sufficient to produce all the crop the shrub was thought capable of yielding. This too, in experienced hands, I think was valuable advice. But inasmuch as a superintendent who may have fifty or hundred men engaged at one time in pruning a field cannot possibly at the same time have his eye on every one of them, watching each cut of every knife, I am inclined to prefer the system of "W." as being the one most easily taught to the coolies,—therefore most likely to be correctly carried out. Thus then we have pruned an estate which was found in tolerable order. Let us suppose the case of one found in very bad order as regards pruning: with trees growing as they liked, matted in the centre, umbrella-topped, exuberant in suckers, abounding in dead wood, and that have not been pruned for years. Trees in such condition I would not attempt to reform all at once: because if I did I would have to cut off the most of the bearing wood, in divesting the trees of all that was unshapely, irregular, or not in accord with the natural expansion of the tree. And that would not pay—for by so doing I would get very little crop for two years. In such case I would begin with suckers, tearing out every one, so as to let me see the tree, and let the sun and air penetrate it. Then I would cut off all dead branches back to where there was life, then I would clear everything within a span of the centre. Then, how then?—aye that is the difficulty, for where there is much vitality, almost all wrongly-directed, it puzzles one to know what to cut and what to avoid. I would begin by training into shape the primaries. Supposing they

have been cut back to parrot sticks, or broken, or deformed, I would cut back to the first eye that is sound and healthy, at the point where a secondary has shot out. By making a slanting cut on the lower side of the primary, but without touching the secondary, the latter will soon accommodate itself to the position and take the place of the destroyed primary, or if a secondary has sprung from the side of the primary at right angles, and if a strong tertiary has sprung out from it, I would cut the secondary at the point of junction with the tertiary, leaving this latter to take the place of the primary. This, however, I would only do if the secondary has so grown, that it cannot be trained to follow the lead of the primary. I would then apply myself to secondaries and tertiaries, taking off such as could best be spared and training those left as far as practicable into their original shape: for it is by a careful selection now of the old wood you have, that the future tree is formed. Thus I would go on systematically reforming the tree: but instead of doing it at once, I would do it gradually over two or three years: even at the risk of offending the good taste of some sprightly young friend, who is an admirer of symmetry. By these means I would retain for the time a good deal of wood of irregular growth, which many planters would be disposed to call *horrid pruning*: but the wood so left would repay me for pocketing my pride, and preserving my sticks: while I would repeat to my fastidious friends that it is my practice to *prefer crop to symmetry*. The tree would thus be trained into shape in course of time without involving too great an immediate sacrifice.

Handling *after* Pruning is equally important with pruning itself, and cannot be dispensed with. The process is already described, but the time of performing this operation demands a passing notice. Within from one to two months after you have pruned, will spring out a rush of young wood especially from the eyes nearest to the parts to which the knive has been applied. These you must take off, going regularly round the tree, like a cooper round his cask, lifting every branch and divesting it of whatever is superfluous. This is your first handling. But you will require another before crop, say about May or June, and this time you ought to be doubly careful, for it is now that you select your wood for next crop. Remember it is not the present crop alone that you have to consider. It has now set and you see it. But most of the branches now bearing it will have to come off next year. Then where will you be for its crop, if you do not leave the wood now? Be care-

ful therefore that you do not strip off anything that will be necessary to yield another crop. You must always have wood for two crops on your trees, that now bearing and that reserved to mature against next year, as wood hardly ever bears till the second year. In very fine soil, or with a very forcing climate, you may require a third handling before crop. And so important is this operation, that if you are not disposed to handle when necessary, you may as well not prune; for the pruning forces out the life of the tree, which left neglected grow to wood instead of fruit.

Manuring is as necessary in a coffee plantation as in any other culture. From the inaccessible position of some estates however, it is not always practicable at a cost which would be warranted. But where it is so, it will always pay. A great impetus has been given to this branch by the opening of the Colombo and Kandy Railway. Previously transport from the sea-coast to the interior was so expensive as to be almost prohibitory to the use of imported manures, while those that can be made on estates are in general far from sufficient to meet the planters' requirements. Cart roads too—which under the wise and liberal administration of some of our Governors, and markedly of the late Sir Henry Ward and the present Sir Hercules Robinson, have been carried out during the last few years, into every producing district,—have most materially aided the planters' efforts in this direction. So much is this benefit apparent that manure, which could not formerly have been transported from Colombo to Kandy under £3 to £4 per ton is now carried up by railway for 12s 6d. As a consequence many new manures are finding their way to the interior, and it seems if a new era in coffee culture had been commenced since the introduction of the railway. The *Mode of Application* depends much upon the nature of the article to be applied. If it be cattle dung—and I know not of any manure yet manufactured or introduced more generally effective than this good old staple—you will require large holes. A basket containing about half-a-bushel is generally considered enough for one tree; although some planters apply two, and I have been told with adequate results. This way takes so much longer time however to go over a field than by the single basket process, and is so much the more costly, that most planters are satisfied with a dose of one basket and going over the field the oftener. Once in three years is generally thought sufficient. But in hungry soil I should like to have half of my estate manured every year. To contain a basket of either cow-dung

or estate-made compost, or any other bulky substance, a hole should be dug about 18 inches long and 9 to 10 deep and broad: made in a semi-circular form, round and above the tree. It may be placed at either side or below the tree; but above is generally more convenient, and less liable to suffer from wash. Fill this hole and cover it up. Another mode which many planters prefer, and which where the soil is rich and free, is doubtless also a good plan, is to make a square hole between every 4 trees, of say 20 inches by 15, or 18, at the discretion of the manager. By this process you are less liable to cut the feeding roots than by cutting near the stem—while on the other hand if the tree be seedy and poor, it may not extend its roots so far as to reach the hole in the centre. In that case to deposit the manure within 9 to 12 inches of the stem will be found the most beneficial process. If it be artificial manure such as Bones, Poonac, Superphosphates, Guano, Sombreorum, or any other concentrated manure, a much smaller hole will do. If the land be flat and there be no wash, 3 inches in depth will suffice. In this way you will disturb very few of the feeders, but will just deposit the manure above them and cover it up. The hole for this kind of manure will be made round the stem and close to it. Should the land be steep, you had better make the hole 6 inches deep and press the earth down on the top of the manure; or the wash may undo the beneficial effects of the dose, by carrying away the manure entirely. To discuss the various *Kinds of Manure* now in vogue would require a treatise for itself, and I cannot therefore enter upon it here. But those I have named are a very fair selection of the kinds in most common use, each of which has its advocates, and there are many more, of which experience will teach the young planter the kind most suitable to his soil and circumstances. For further information on the different kinds of manure in use among planters, and the modes of application, I quote the first Report of a Sub-Committee of the Planters' Association appointed by that body to consider the manuring question, and which Committee is still sitting:—

Proceedings of a Meeting of the Sub-Committee, appointed in October 1868, *to consider the Manuring Question held in Kandy, on Wednesday,* 1*st September* 1869, *at* 12 *noon.*

Present—Messrs. A. Brown, W. Bowden Smith, W. D. Gibbon and the Secretary.

1. Mr. W. Bowden Smith was requested to take the chair.

2. The Secretary then proceeded to read draft of the proposed report. The draft having been carefully consi-

dered, and such alterations made as were considered necessary, the following form was finally adopted:—

"The Sub-Committee, appointed in October 1868, to consider 'The Manuring Question,' beg now to come forward with an account of their labors; and though the result of their enquiries may not be so satisfactory as might have been expected, yet they trust that their efforts have not been in vain, and that these preliminary enquiries will be the means of drawing attention to so important a subject, and induce those engaged in manuring operations, to keep more careful records of their work than seems to have been the case hitherto.

"Your Sub-Committee issued in October 1868 to the members of Committee, for circulation in their respective districts, a series of Questions bearing on the different points on which information was sought. Of these lists of questions 152 were circulated, but it is a matter of regret that the Sub-Committee have only been favoured with 25 answers from the following districts:—

"Ambagamuwa 3; Badulla 1; Dumbara 3; Hantane 4; Hewaheta 1; Kadugannawa 1; Kotmale 2; Kurunegala 2; Knuckles 2; Pussellawa 4; Sabaragamuwa 1; Udapussellawa 1.

"The reason for this, your Sub-Committee are led to believe, arises, not so much from an unwillingness to give information, though it is the case in some instances, as from inability to give accurate information for want of proper records.

"That Manuring operations have been carried on extensively for a number of years there is no possible doubt, but, from various causes, till very recently no authentic records seem to have been kept of the nature of manures applied, the cost of same, and relative effects, and the Committee are therefore met with difficulties at the outset in arriving at conclusions for want of sufficient data.

"The manures generally applied, as collected from the reports sent in, seem to be the following:—

"1, Cattle manure; 2, Pig manure; 3, Poonac and Bones (in proportion of 2 to 1 in weight); 4, Bones and Guano; 5, Pulp; 6, Pulp and Lime; 7, Cattle manure and Pulp; 8, Bones and Pulp; 9, Bones, Pulp and Guano; 10, Eureka; 11, Guano, Peruvian, Bolivian, Bird Island and Phospho; 12, Sombreorum; 13, Fish; 14, Ashes; 15, Animal Charcoal; 16, Phosphoric Potash; 17, Sal-ammoniac and Poonac; 18, Sulphate of Ammonia; 19, Dissolved Bones and Swamp Soil; 20, Cuera; 21, Compost, Leechman's; 22, Compost, Cattle Manure, Bones, Pulp, Coffee Husk and Mana Grass; 23, Compost Vegetable matter saturated with diluted Sulphate of Ammonia; 24, Compost Poonac (1 cwt.), Bone Dust (½ cwt.), Bolivian Guano (¼ cwt.); 25, Compost Cattle manure, Pulp, Mana Grass, and rubbish; 26, Compost Pulp, Line manure and mud from drains; 27, Compost Poonac (5-8ths), Bones (2-8ths), Guano (1-8th).

"The mode of application seems to be to place the bulky mauures in holes varying from 1½ ft. × 1½ ft. in the square, and in depth from 6 inches to 18 inches, and about 6 to 18 inches from the stem of the tree.

"the artificial manures being placed in smaller holes of less depth. On one estate the plan seems to have succeeded of placing a large quantity of pulp (5 baskets) in holes cut in a space between every four trees, at a cost of £9 per acre and a yield of 18 cwts.

"The quantities of the several manures seem to be as follows:

"Phosphoric Potash ½ lb. to tree. Bonedust and Poonac ¾ lb. to 1½ lb. per tree. Leechman's ¾ lb. to 1 lb. per tree. Cattle Dung 1 basket full to 3 baskets (30 lb.).

Sombreorum: 4 to 7 oz.

Bones: ¾ lb. to 1 lb.

Cuera: ¾ lb. to tree.

Composts: Pulp, Lime and Ravine Soil 1. ½ lb. Lime, 1 bushel Pulp.

Do. 1 bushel Ravine Soil.

Do. Dissolved Bones (1 lb.), and Swamp Soil (1 basket).

Do. Bolivian Guano (½ lb.), Peruvian (¼ lb.), and Bones (½ lb.)

Do. Cattle manure (1 basket), Guano (3 oz.)

"It seems from the reports that the cost of cattle manure, including application, varies from £4 1s. 6d. to £10 10s. per acre, according to the facilities for grazing of cattle, transport of bedding and manure, and other circumstances. Of other manures the cost, as can be gathered from the reports is as follows:—

"Artificial manures £6 2s per acre; Bones and Poonac £5 10s. to £8 per acre; Leechman's £7 10s. per acre; Sombreorum £3 to £6 10s. per acre; Bonedust and Ashes £10 to £12 per acre; Poonac, Bonedust, and Bolivian Guano £7 2s. per acre; Poonac, Bonedust, and Guano (No. 27) £6 15s. 3d per acre; Pulp £1 16s. 6d. to £2 10s. per acre.

"Of the relative effects of the manures, the following seems to be the result deducible from the majority of these reports:—

"1. That Cattle manure is *par excellence* the best and most lasting. The effects remaining over two to three years.

"2. Next in order come Bones and Poonac, which are said to be good from one to two years.

"3. Guano alone is considered too stimulating and not lasting; but in mixtures (in small quantities) with Bones and Poonac seems to have a very beneficial effect.

"4. Several of the writers speak very favorably of the application of Pulp; and one indeed goes so far as to put it on a par with Cattle manure.

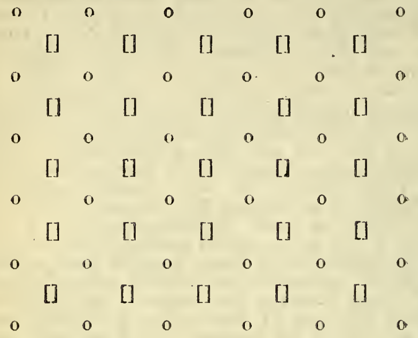
"The Sub-Committee would beg now to make the following suggestions with regard to mode and time of application of manures. First, that all lands except such as have little or no slope should, in the first instance, be carefully drained, that bulky manures should be placed in holes of not less size than 2 ft. × 1 ft., and not exceeding one foot in depth, and at a distance of from 9 to 18 inches from the stem of the tree. That artificial manures should be in semicircular holes above the tree,

and not exceeding six inches in depth, and the manure should be well mixed with the soil previous to being covered. That the best time of application of cattle manure and pulp, which are longer in taking effect than some of the artificial manures, should be as soon after crop as possible, whereas artificial manures can be kept for a later period of the year, till the rainy season commences. To those gentlemen who have taken the trouble to furnish detailed statements of the cost of the different kinds of manure and their application, the Sub-Committee have to return thanks, and especially to Mr. Corbet for a valuable set of tables shewing the cost of mannres. Yet, with a great deal of valuable information before them, it seems to the Sub-Committee very clear, that the Reports sent in for the most part shew a great paucity of results. Very few planters appear ever to have accurately tested these. This could only be done by setting aside certain rows of coffee of an average field for each kind of manure—if running up from the bottom to top of a hill so much the better, as the effects would be the more observable. On either side of these manured rows should be left as many unmanured, so that the contrast would be visible. These manured rows ought to be picked separately from the rest of the estate. A distinct account should be kept of the produce of each set, and samples of the coffee put aside, so as to enable the manager to judge as well of the quality as of the quantity.

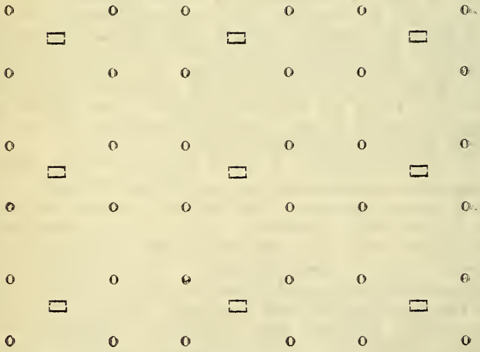
"In order to carry out the above suggestions, and to turn them to practical account, your Sub-Committee are of opinion that planters should be invited to co-operate with the Committee, and that one or two gentlemen in each district should be appointed to collect reliable information, based on future experiments, and submit the results quarterly to the General Committee till the full effects of manures are fully tested."

In this connection I shall mention *Water Holes*. These were first introduced as holes intended to be filled with manure. The article however running short the holes remained open, and it was found after some time that the tree took a fresh start of growth, partly perhaps caused by the temporary exposure of the roots to the sun and air, and partly by the loose earth that gradually dribbled into the hole again, together with whatever accumulations of leaves, timber and other decayed vegetable matter lay about on the surface of the ground near. It has since become a system to make water holes between every four trees, or between every 8 or 12 trees. These are generally made about 2 feet square by 1 foot deep, or 20 inches square, or 18, according to taste and space. If the object be to collect water and save wash, the more holes the better, while if it be in a dry district, and intended to catch the accumulated surface *débris*, by slipping four trees on each side, or say by opening a hole between four

trees, then passing over four to the next four, both up the line and across the field, you will admit sufficiently of every tree getting a taste of the fresh earth as roots from every tree may thus reach a hole and draw sustenance from its contents. The first described process will be thus :—



The second thus :—



By the former process we find 25 holes in 6 rows of 6 trees each. In the same number of rows and trees of the second style we find only 9 holes. By the first process every four trees draw nourishment from five holes. By the second, every four trees have a hole to themselves. The latter is of course the more economical plan, while the former opens up the land the better, and provides space for collecting more of the surface wealth of the soil which otherwise too often finds its way to the sea. II.

your trees be old and their roots exposed, you will do well to throw what you take out of the holes over the exposed roots. The loose earth about them and the cover from the blazing sun will serve as well as a manuring to the fields so treated: and when in course of time it washes back, the hole is there to catch it up.

THE BEARING in full of the coffee tree begins in the third year from its being planted out. Then the tree generally yields its first full crop. It gives what is called a maiden crop in the second year. This sometimes amounts to a considerable quantity. I have known estates yield from 7 to 9 cwts. per acre in the second year. This is unusual however, and is generally the result of particularly good soil and a particularly favorable season. Low estates with good soil yield as a rule a much larger first crop than do the higher altitudes. Yet from a field on a plantation at an elevation of 4,000 feet above the level of the sea, I once had 9 cwts. per acre at 2 years and 2 months old. It was good soil and in a dry climate. A high elevation combined with a dry climate generally bears well. A high and wet climate on the other hand sends a great deal of its growth to wood. The sap that would otherwise nourish the berry goes to a considerable extent to feed the branch. This tendency to excessive production of wood requires to be kept in check by judicious handling.

THE BLOSSOMING is the most beautiful sight that can greet the planter's gaze. For weeks before it opens, he has seen the buds peering out from every branch, studding the tree all over like jewels in a casket. He has watched their spear-like form pushing out into longer spikes until ready to burst: and then he rises some fine morning to find they have opened during the night, and his fields are covered with full-blown flowers, white as flakes of driven snow, loading the air with the most fragrant perfume. This is also an anxious period, and he watches his trees with care till these blossoms set. No work is allowed which may shake the tree or rub off the flower. Pruning is stopped, and weeding and all works which would bring the laborers in contact with the blossomed fields. This is a precaution within the planter's power. But he has no control over the elements, and must be watchful still, for too much rain at this period may wash off a blossom, while too much sun may burn it off. The same great Being, however, who "tempers the wind to the shorn lamb," moderates the elements to suit the blossoming season. And we generally find, for a few days about this time, close, cloudy, and hazy weather, dense fogs fre-

quently obscuring the sun, and keeping his fiercest rays in check. The blossom once fairly set, the planter may form an approximate estimate of what his crop will amount to. From blossom till crop there is a lapse of about seven months.

CROP-TIME is to the planter the most interesting period of the year. For it he has worked, and waited, and hoped, during the three preceding years, if a new estate; and if an old one, his reward or the labors of the year is now in view. For it he must be prepared with a force of laborers twice as large as during the rest of the year, if his estate have been weedy, and four times as large if it be clean. The laborers are chiefly Tamils from the Indian Continent who immigrate to this island in search of employment. Many of them come and go for crop gathering, as the Irish laborers come over to England for the harvest, returning to their country after it is over. Sinhalese also are frequently available for this work: but they are not such good pickers as the Tamils, while they expect more pay. When the coffee is ripe on the trees it is called cherry: the outer covering called the pulp resembling in size and color that of a ripe English cherry. Inside this are two beans, enveloped in covers or cases like parchment, and called by that name. Again, the silver skin, inside the parchment, is a thin coating which adheres to the bean, and of which it is only divested by drying in the sun during the preparation for shipment at Colombo.

CHERRY RIPE is a pretty sight. None more lovely, animating or interesting can present itself to the ardent planter than his fields of coffee trees laden and borne down at every bough with rich clusters of blood-red fruit. One such tree in heavy bearing would be a meet sign for a fruiterer's shop. And glad would an English fruiterer be to have such a sign-post. With fair soil, climate, and season, the tendency of the coffee bush is to bear heavily. Sometimes as much as 2 and even 3 lb. may be gathered off one tree. Yet 1 lb. per tree over a field or over an estate is a high average. This is of course 1 lb. of clean coffee—of the bean itself after being divested of the pulp, parchment and silver skin. It is plucked from the tree by the hand—the coolies picking regularly in rows. Each man takes a row or two rows if crop be not heavy—and proceeds up it regularly, dropping his pickings into what is called a cooty sack, or small bag slung round his waist with a string, capable of holding from $\frac{1}{4}$ to $\frac{1}{3}$ of a bushel. When full, he empties it into a large two-bushel bag, which he has left on the nearest road at a convenient distance from where he is pick-

ing—and so he goes on filling his cooty-sack and emptying it into the large bag till he has got his two bushels—the day's task when an estate is in full picking. But $1\frac{1}{2}$ bushel, 1 bushel, $\frac{3}{4}$ and even $\frac{1}{3}$ have sometimes to be put up with, when crop is either not fully ripe, or when it is very light on the trees. The superintendent must judge of the quantity to be fixed as the day's task by the state of his crop. He will soon know what the laborers can gather and will fix the task accordingly. It is well always to do this work by task rather than for day's pay. It stimulates good pickers to extra exertions, by which they gain extra pay, and it coerces the sluggish into full work: for there are great opportunities at this work to loiter between the rows or around a large tree. When in full picking, a good hand will sometimes bring in an extra bushel, or even two: and, when he does this, his pay rises in proportion. So, as it is an interesting time to the master, it is also a profitable time for the active laborer on an estate. A common plan is to give ready money for the extra bushel. This, which the coolies call *kai kasi*, greatly stimulates exertion, and is much liked by them. There is, however, the danger, that by placing too much money in the cooly's hands he will become idle while it lasts and shirk work: for, although coolies are expected to turn out to work every working day and are paid accordingly at the month's end for every day they have worked, there is no slavery here, laborers being treated like free laborers at home or elsewhere, and they have many opportunities of pleading illness or absenting themselves from work beyond the master's utmost vigilance to prevent. It is better ther fore to give them tickets for these extra bushels, retiring them on pay-day or at the end of crop. This precaution is necessary, for the double reason that seldom has an estate when in bearing more coolies than it requires during crop-time, and therefore it cannot afford to have any off-work where avoidable; and 2ndly, because Ramaswami with money in hand is prone to be off to the villages or nearest town to spend it, never allowing master's necessity to interfere with his pleasure or convenience; or in fact taking the trouble to think that his acting thus causes his employer frequently heavy loss; for labor at that critical time is generally in such demand that it can neither be hired nor borrowed. There is less danger in the practice now very common of paying ready cash at the rate of a penny when the second heaped bushel is brought in, as this requires time to accumulate to a sufficient extent to draw the cooly off the estate, while it gives him a little ready

money in hand for procuring necessaries or comforts there.

The Cherry Loft or upper floor of the pulping-house is the place where the cherry coffee is measured, as it comes in from the field, each picker receiving a ticket to denote the quantity he has brought in. These tickets are retired at the end of the day, week, or month by placing the laborer's name in the check-roll for the quantity he has brought in. In the cherry loft is a hole about 6 inches square, right over the pulper through which on withdrawing a trap door it is allowed to fall into the pulper where it is divested of the pulp.

The Pulper is just a nutmeg-grater on a large scale, standing on a frame of about 4 feet high, consisting of a cylinder set horizontally, covered with copper punched on wood, about 2 feet long by 1 foot diameter, which, on being turned, presses against two bars or chops, one set close enough to crush off the skin or pulp, which is dragged backward by the cylinder, goes out behind and is carried away by a spout to the pit in which it accumulates for manure, while the seed or bean drops down into a sieve below attached to the machine. The other or lower chop is set so close to the cylinder, that the beans cannot pass through. They therefore pass out in front, and falling on the beforenamed sieve are thrown forward by an oscillating motion, till after a few tossings they fall through into a spout below which carries them into a trough or cistern in front—and any pulp that may have found its way forward with the beans is again gathered up and thrown into the hopper or box on top of the pulper which receives the fresh cherry from the cherry-loft. With it this pulp, which is called tails, is made to perform another revolution; during which process most of the beans are squeezed out and mix with the rest of the parchment coffee in the cistern. Any that escapes a second time with the pulp on it is afterwards either trampled out, and washed as second quality when time permits, or is dried and the husk separated from it afterwards. This description of a pulper refers to what in planter parlance is called the old "Rattletrap,"—the same machine described by "Laborie." But there are many new inventions since, which space will not permit of being particularized here. Suffice it to say that, after all the modern improvements, a well-set rattletrap will generally be found to do its work as clean and well as any one of them.

The Cisterns are sunk into the ground in front of and below the pulper floor, and consist of Receiving Cistern or Cisterns, Washing Cistern, and Tail

Cistern. I shall describe one of each.

THE RECEIVING CISTERN may be 10 or 12 feet square or larger or smaller according to the requirements of crop. But say 10 feet square by 2½ feet high as a medium size. Into it goes the coffee fresh from the pulper. Divested of the skin a gummy substance adheres to the parchment, rendering it difficult to wash till fermentation has set in, liberating this gum from the bean. It is left therefore in the heap in the receiving cistern for a night on a low estate, while it takes two nights on a high one to fit it for washing clean. The washing process therefore begins on the first or second day after being pulped. But for this purpose the then fermented coffee is drawn into the washing cistern through a door which communicates between the two.

THE WASHING CISTERN may be assumed as of the same size as the receiving one. There the coffee is first trampled for a while by men's feet to loosen the gum, then drawn up in a heap at one end, clean water is run in from above by a spout, the coffee is dragged about by a sort of blind-rake called a *matapalaka*, and is made to undergo two or three waters till quite clean, all the gummy water having been allowed to run off. This, when utilized, makes a very good addition to a dung-pit; but very few planters take the trouble of turning it thus to account. I have seen it added to a pit filled with mana grass compost with great effect.

THE TAIL CISTERN is a small cistern, of say the same length and half the breadth as the others, into which the light coffee which floats on the surface at the time of washing is drawn. There it is washed and kept separate from the heavy coffee. When properly washed, the coffee is spread out on a barbacue or levelled space, adjoining the store and pulping-house, which buildings if not contiguous should always be near each other, so as to diminish the labor of carrying the wet coffee from the pulping-house, and the dry coffee into the store.

THE BARBACUE is a levelled piece of ground adjoining the store. When properly made, it is covered with from six inches to a foot of broken metal, well pounded down, covered again with sand to fill the interstices, then coated over with chunam or lime, and polished on the surface, or it may be tarred on the surface, or it may be laid with brick and tarred; or with large flat stones, or chunamed or tarred. Many planters are satisfied however with just a levelled space of ground pounded down to make an even surface. In this case mats must be spread out to keep the coffee clean and free from contact with the

earth. Again some planters prefer trays or platforms upon which to dry the coffee. These consist of tables set on posts, the tables being 4 or 5 feet wide and as long as the space admits. They are covered with waratchies, or reepers, and a mat spread over them to keep the coffee from falling through. Two or three days will generally suffice for drying the coffee fit for transporting; or for retaining in store if the weather be too wet for despatching. It is then sent off to Colombo, the port of shipment, where it undergoes the processes of peeling, sizing, packing, and shipping. These I need only briefly describe; as they form no part of the planter's work on the estate, but may be convenient for him to know.

On this point, however, I may be asked why send the coffee to Colombo for preparation. Why not do this on the estate and save the carriage of the parchment? Because there is seldom sufficient drying weather on estates in the interior at the time when the crop comes in, and because labor is more plentiful in Colombo for such work; also because it would greatly interfere with the labor of the estate which is usually all required immediately after crop to put the estate in order by weeding, pruning, &c., while in Colombo at that season there is abundance of labor and always bright sun. Arrived at Colombo then, the coffee is first spread out on barbacues, where it gets one, two, or three days' drying as it may require to fit it for peeling. It is then put into the peeler. This is a large circular trough in which a wheel about 6 feet in diameter and about 1 foot in breadth, like a gigantic grindstone suspended, is made to run round upon the coffee, bruising the parchment into chaff, and leaving the beans unhurt. They are afterwards passed through a winnower to take off the silver skin. Then through a sizer, which divides the sizes into No. 1, 2, 3, and peaberry. Thereafter it is packed in casks or bags and shipped.

Having thus cursorily described all the necessary operations of the planter, from the felling of the first tree to the gathering in and despatching of his crop, I shall take my leave of the reader, hoping that this humble effort to inform the tyro in Coffee Culture will be received in the spirit in which it is meant, not as a full and complete Treatise on Coffee Cultivation, but merely as a Handbook for Beginners, placing before them, simply and concisely, the routine of duty that will devolve on them in this pursuit. The want of such a portable little work which any man could carry in his pocket to the field or elsewhere has long been felt: and in my early planting

days no man would have more highy appreciated its possession than myself That it may be found useful to the class for which it was intended is my earnest wish and hope. Let no one however suppose that I recommend the embryo planter to proceed, even if he have the means, with this little book in his pocket, to make an estate for himself. He will drop plenty of money if he tries it. There is much to learn in Coffee Planting, that he will not find written in these pages, much that experience alone can teach him, and much that he can only learn *in time* and *by* practice. He will act wisely therefore, be he ever so smart, or well supplied with the necessary finances, to place himself for a time under the instruction of some senior in the art, from whom he will gradually acquire a practical acquaintance with this very interesting branch of agriculture.

ALEX. BROWN,
April 1871. *Kandy, Ceylon.*

APPENDIX :

ESTIMATE FOR OPENING A COFFEE ESTATE.

This treatise would not be complete if it did not furnish a table to shew at what rate a Coffee Estate can be opened and brought into bearing. So much of the cost, however, depends on the mode in which the work is done, the nature of the ground, the abundance or scarcity of labor, and though last, not least, the habits, expensive or economical, of the manager, that the sketch I am now to give will doubtless be found to differ materially from the experience of many of my fellow planters. With careful management, however, I consider the scale is liberal, and I have known the work done for a lower figure—£15 per acre is I am satisfied a fair allowance to bring an estate into bearing: and it will be seen that in detail it works out at this. Yet I have known a new clearing opened and brought into bearing for £10. And I have even heard of its having been done under peculiarly favorable circumstances for £8. In this table I assume that the planter starts with a block of land of 200 acres —that he opens only half of it—keeping the balance as a reserve to be opened at his convenience. And that he works with his own money. Such a clearing will generally be managed by a neighbour—which is the most economical way till it arrives at the 2nd year. Hence, till then I fix the salary at only £100 per annum. After that, with buildings to put up and crop to gather; as well as new land to open, the item of superintendence will increase.

Estimate for bringing a Coffee Estate into Bearing in Ceylon.

1st Year.

200 acres land at average value say £3 per acre			£600
Felling and clearing 100 acres @ £2 5s. =		£225	
Pegs		15	
Lining		10	
Tools		30	
Holing		200	
Planting		50	
Lines for laborers...		30	
Superintendent's bungalow		50	
Plants		75	
Weeding, 1st six months... ...	£90		
Ditto, 2nd six months... ...	£45		
		135	
Superintendence 1st year		100	
			£920

2nd Year.

Weeding	£100	
Supplying	50	
Roads	50	
Topping	10	
Suckering	10	
Superintendence	100	
		£320

3rd Year.

Ordinary work as last	£320	
Extra to Superintendent...	100	
Handling	30	
Pulper	30	
Pulping House	50	
Temporary Store	100	
Crop, Gathering and Curing ... } 600 cwts. @ 6/8 ...	200	
Transport to Colombo of 3,000 bushels Parchment @ 1/	150	
		£980
		£2,820

Cr.

By value of 600 cwts. of Coffee at 50/ in Colombo	£1,500
Estate now three years old, stands to the debit	£1,320
And should be worth	£5,000

N.B.—The other 100 acres could, if all available, be brought into bearing for £1,500, when the estate if it had been well cared for should be worth £10,000. It would then, however, require more permanent and therefore more costly buildings.

PART II.

THE COFFEE PLANTERS' MANUAL

(*Continued*).

BY A. BROWN.

[The following additional remarks were written after the "Manual" had been reprinted from the CEYLON DIRECTORY; but they ought to be read along with what is said under the same headings in the body of the work.]

LINING.—Pegs made and lining rope ready, the next thing is, with the aid of a compass or common cross staff, to lay off in sections the clearing to be lined. To do this, place the instrument as near as possible in the middle of the field and where a good long sight can be had. With this, place poles at short distances, the length of the field in the direction most suitable for the future working of the estate. If it be intended to have the lines to run in one direction only (and more than this is fancy, and unnecessary work) the pegs in this line may be placed by the lining rope. At right angles to the first line, and also about the middle of the field, run another line which will divide the field into four sections. This line cannot, like the other, be pegged by the lining rope, as the distance on sloping ground would be incorrect, and the lines zigzag as the surface varied. Stretch a rope from pole to pole, and with a measuring rod place the pegs at the distance it is intended to have the lines apart. In measuring up or down hill, the rod must be held horizontal and the peg dropped from the end of it. The field now laid off into sections, these can be taken up in rotation, lining all from the horizontal line. A cooly will place one end of the rope at the first peg from the perpendicular line, and another at the other end will measure with a rod the distance and place his end, drawing the rope tight and straight; other coolies then drive the peg at the marks on the rope, and so proceed line by line across the field, always returning to the perpendicular line to take up a fresh length. The measuring rod must always be held level and at right angles. If laid on sloping ground or held obliquely, the measurement will be incorrect. To assist in measuring, one end of the rod may be made in the form

of a square to place against the rope. Bad lining after an estate is formed cannot be remedied, and therefore care is amply repaid; good lining both adds much to appearance and aids the future working of the property.

Roads.—Have two sets of pegs, the one four, the other fifteen inches in length. The position ascertained by the tracer, drive one of the short pegs flush with the surface, and a large one close beside to mark it; and so proceed. Inside of these, measure and line off the road at any breadth agreed upon, making allowance for depth of bank, and cut down to the level of the short pegs.

Manuring is no doubt a different kind of thing on old and worn estates from what it is on new or comparatively young places. From the former, after many years of cropping, some of the most important elements that go to compose the coffee tree and the coffee bean have doubtless been extracted to a much greater extent than can have been added by any system of manuring hitherto practised. Such soils, therefore, require to be made up. New estates or those but little worn may have parted with only a few of those elements which have been exhausted on the older lands. A mere 'fig-up,' so to speak, may be all they require; and a pinch of Sombreorum or a few ounces of Bones, Poonac, or Superphosphate, may supply the desideratum for a time. Even on new lands, however, these very stimulating manures should be used with caution and not alone. Mix them with some bulky substance, such as ravine soil, decayed cattle manure, jungle soil, rotten wood, leaves, grass, or vegetable matter of any description. You will thus add substance to the soil as well as a stimulant. Mana grass both buried and laid on the surface has been found very effectual; as a manure sprinkled over with a little sal-ammoniac it soon decays. If placed in layers in a pit 6 to 10 feet deep, each layer sprinkled with sal-ammoniac in a liquid state, it will be fit for applying in about four months, when if it has been kept covered up, it can be cut up with the mamoty like cheese. If the pulp water has been allowed to run over it in the pit, it assists its decay and improves the compost greatly.

A very good mixture is

5 oz. Bones 8 oz. Poonac 4 seers pulp or jungle or ravine soil or decomposed cattle dung	applied to each tree.

Another good mixture where the trees are in robust health is as follows:—

2 cwt.	Superphosphate of Lime	½ lb. per tree.
1 ,,	Bone Dust	
½ ,,	Sal-ammoniac	
¼ ,,	Guano.	

As another mixture, night soil and common earth, has been found a most effective manure. By having a latrine near every set of lines, and seeing that they are made use of, a good deal of this valuable manure can be collected and turned to useful account. While on the subject of manures, and before leaving it, I am glad to have the opportunity it affords me of rescuing from the oblivion into which it had very undeservedly fallen a valuable paper written by Mr. Perindorge about twenty years ago, describing a compost and the way to make it, in different forms called *Perindorge's Manure*. The paper was not published by him. It was considered too valuable for that. But the secret was sold for a large sum to two gentlemen of the planting community who retailed it (the paper) at £5 per copy. The manure was found very valuable; and not very costly where the requisite vegetable matter which forms the basis of the compost can be had in abundance. This is not always the case however, and, even where it is, the manufacture gives trouble, and therefore has to a great extent been allowed to slip out of use. As I was one of the subscribers, I feel no hesitation now in giving the paper thus freely to the public, and hope it will be the means of reviving a process which was found when first introduced to form a cheap and effective manure. In the neighbourhood of patanas especially ought this manure to be easily made, as well as where jungle is convenient, as the leaves of jungle trees do as well as grass :—

PERINDORGE'S MANURE.

INSTRUCTIONS FOR PREPARING A HEAP OF 2,100 CUBIC FEET OR ABOUT 40 TONS.

In any convenient part of the estate, and near a small supply of water if possible, erect with jungle posts a kraal or pen 30 feet long, 10 feet wide and 7 high. This may be easily done by digging a trench 2 feet deep around a space of ground of those dimensions, setting up the posts closely side by side, and pounding in the clay well about their feet. The posts do not require tying as they are merely intended as walls to retain the heap of manure for a short time. A light and temporary roof of branches is also desirable to keep off the sun and part of the heaviest rain which might wash through the heap.

The bottom or floor of the kraal ought to be sunk a foot or two lower than the surrounding ground, to prevent the escape of the liquid manure.

Commence making the compost by spreading on the floor of the pen a layer about 18 inches thick of fresh

weeds, grasses, leaves, small succulent branches, or in fact any kind of green vegetable matter. If the vegetable matter, of whatever sort, be long, it ought to be chopped, for the purpose of facilitating the removal and application of the manure afterwards. At the same time put a layer of earth next the posts to prevent drainage at the sides; but on the second occasion of using the kraal this edge stratum may be conveniently formed of a little of the manure that was previously made.

Over the 18 inch layer of weeds, &c., spread some cattle manure—the more of course the better—but a few inches—say six—will be sufficient.

Then pour over the heap as equally as possible a portion—say one-sixth part—of Pickle No. 1, well stirred up before use.

The same process is to be pursued daily until the pen is filled somewhat above the tops of the posts. Nothing more should then be done for a week, with the exception of taking care to keep the heap moist by sprinkling water over it occasionally, or even daily if necessary in hot weather.

At the end of a week make holes with a long crow-bar down through the heap about one foot apart, and funnel-shaped at the top, to within 18 inches of the bottom, and pour into them one-third of Pickle No. 2.

Next day make other holes between those first made, and to within 3 feet of the bottom, and pour in the same quantity of the Pickle No. 2. On the 3rd day make the holes to about 5 feet from the bottom and pour in the remainder of the pickle.

Then cover over with old manure or soil, and in a week or 10 days the compost will be fit for application.

PICKLE No. 1.

Put 2 bushels of bone-dust, 1 bushel of woodashes, and about a quart of fresh burnt lime, to steep for a few days in as much water as will cover them. Then throw them into a mixture of 20 gallons of ferment and 300 gallons of water. Add a bushel of lime, and mix all well together. Stir them up also when taking out part to apply.

Note.—The object of macerating the bone-dust in potash and lime is to remove the oil which prevents bone from speedily decomposing. The oil is thus converted into soap; and the plant is then enabled to make use of the phosphate of lime contained in the bone. This pickle can be made in smaller quantity for convenience. A couple of beer casks would hold 50 gallons or a sixth part of the above—that is sufficient for a day's consumption in making 40 tons of manure.

The "Ferment."—Take 5 gallons of molasses, 15 gallons of water (warm is preferable): mix together in a beer cask or other suitable vessel, and keep in a close warm room for a couple of days, when it will be fit for use. This will be ascertained by a scum or froth rising on the surface. If molasses are not procurable, common coarse sugar or jaggery may be substituted in the proportion of 8 lb. to every gallon of molasses.

NOTE.—The Ferment is most required on cold, high estates.

PICKLE NO. 2.

Sal-ammoniac, 20 lb.; Common Salt 20 lb.; 10 gallons of Ferment, filled to 300 gallons with water. 20 lb. of Saltpetre may be added if easily procurable, but it may be omitted with very little detriment.

Add any fresh Cattle Manure that is to be had.

NOTE.—The salts should be thoroughly dissolved in a sufficient quantity of the water before mixing them with the other ingredients.

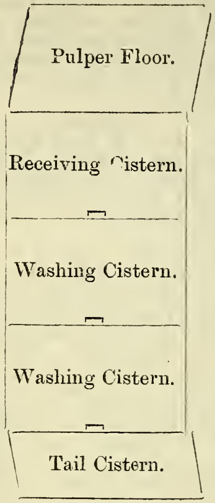
Remarks.

Thus, in about 20 or 25 days from the commencement of operation, there will be made a heap of most valuable manure, which ought to be sufficient for four acres of coffee at the rate of ½ bushel for each tree, but, of course, the quantity must depend upon the more or less exhausted condition of the soil.

The object of the above process is in the first place to hasten decay in the vegetable matter by artificially exciting fermentation, and the chemical changes dependent upon that action. This effected, the other materials which the vegetatable matter does not possess in sufficient quantity for the coffee tree are then added, and in a manner that prevents their dissipation or loss. The whole mass is thus brought into the condition most suitable for being taken up by the roots of the tree. Cattle manure is of course the best form under which nutriment can be furnished to most fruit-bearing trees; and the compost as above made is a tolerably close imitation of cattle manure. It must be borne in mind that cattle discharge no materials as manure—either excrement or urine—which they have not previously taken in with their food. The vegetable matter which forms the basis of this artificial manure being however inferior in quality to what cattle generally consume, and being rather deficient, although not altogether wanting, in some materials, these are added in a manner not only most economical, but also calculated to preserve them from loss. The cattle manure used is included not only for its own inherent value, but for assisting, by a well-known chemical law, the assimilation of other materials to the same condition as itself. A few cattle will sufficiently answer this purpose, although the amount of their manure if used alone would be of little avail. The cow is a small natural laboratory in which chemical changes are continually going on; and the heap above described is, for the purposes of manure making, an artificial imitation of the cow on a large scale. Rather, it should be said, the heap closely resembles so much farm-yard manure—that it consists of a supply of carbonaceous matter in the condition most suitable for supplying the plants with this prime necessary; with the salts (both of excrement and urine) universally, equally, and in sufficient quantity diffused throughout the mass.

CISTERNS is the next point on which I consider a few additional observations desirable. There are vari-

rious vays of constructing these. A very common way is to make them in a line out in front of the pulper platform and below it thus :—



And the floor of each cistern is on a slope of a few inches, each inclining outwards, the object of the inclination being to facilitate the washing and removal. When the parchment has sufficiently fermented in the receiving cistern, the door communicating with No. 1 washing cistern is opened and the coffee drawn through. To clear No. 1 of its washed coffee and leave room for the second day's washing, the same process is performed, and the coffee drawn into No. 2 washing cistern. At end of No. 2 is the tail cistern, which is depressed a few inches below No. 2, so that the light coffee which generally floats on the surface overflows into the tail cistern. This is a style of cistern accommodation very common, or they may be doubled in number by simply putting a division down the centre. That may be left however to the taste and requirements of the planter constructing. The simple set of three large and one tail cistern is however sufficient for my illustration. On the same scale then I will shew what I consider a better plan, the three large cisterns as before running out in line from the pulper, but each cistern independent of the other and the tail cistern running along the whole length

of the three, thus :—

<table>
<tr><td>Receiving and washing.</td><td rowspan="3">Tail Cistern.</td></tr>
<tr><td>do.</td></tr>
<tr><td>do.</td></tr>
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In this way each of the three large cisterns is both a receiving and a washing cistern, and the tail cistern receives the floatings of them all. By these means the shifting of the contents of the one into the other is avoided, and time and labour saved, as there is no communication between the three : a spout merely conveying the pulped coffee from the pulper into the cistern intended to contain that day's pulping. You could thus be operating, if need were, on three days' pulping at one and the same time without confusion or trouble. Another point to which I would direct attention is the inclination or slope of the floor of the cisterns. This, as I have before shewn, is generally made outwards. But a better plan is to slope it inwards, and have a back or side trap-door through which to pass off the dirty water after the coffee has been washed. The manipulation of the coffee in this way is easier, and the operators have it better in command when it lies at the lower than when drawn about by the 'mattapalaka' at the upper end of the cistern. The water covers up the coffee, and the light beans during the operation of turning or stirring readily float to the surface. I have seen this process in excellent working on an estate in Dimbula. The door may even be at the upper end of the cistern, as the angle of the incline is so gentle, that almost all the water flows off with a rush when the door is opened, carrying the floats along with it; and what little water remains with the coffee undisplaced will drain off as the coffee is lifted out upon a grating outside the cistern : a very convenient mode of separating the remaining water from the parchment, as the water passes through the grating and goes off in a spout underground, while the coffee remains high and dry, to be afterwards conveyed to the barbacue.

The Estimate for bringing a small estate into bearing is the only other point on which I find it necessary to make a few remarks. It will be seen that I

reckon this at £15 an acre. The estimate when worked out, however, would, if unexplained, shew a higher figure. If the cost of the land, which is the plant; extra to superintendent 3rd year; pulper, pulping-house, store, cost of gathering and transport—all charges against crop after the estate has been brought into bearing—be deducted, the result will be very close on what I have stated; and, besides to be very economical, a saving might be effected on roads, and on supplying if the seasons have been favorable.

A. B.

"THE COFFEE PLANTER OF CEYLON."

[A Review of Mr. Sabonadiere's "Coffee Planter of Ceylon," by the Editor of the "Ceylon Observer."]

February 1871.

First Notice.

A careful perusal of Mr. Sabonadière's valuable manual gives us a more vivid idea than ever of the mistake which some people commit in supposing that any half-educated person will do for a coffee planter; that less of natural intelligence and acquired knowledge is requisite for the tropical agriculturist than for his brethren, who are destined for the walks of commerce or the ranks of the civil and military services of government. We fear that much of the loss and disappointment which proprietors have had to mourn over owe their origin to the fallacious notion we have referred to. To make a good coffee planter, as to make a good anything else, a man ought to have a sound mind in a healthy body. A robust constitution is perhaps more to be desiderated in this line of life than in those of commerce, banking, the civil service, and the learned professions. A conscience guided by Christian principle, too, is here of the last importance. Why have so many, who began a coffee planting career so well, broken down, and why are the experienced planters who can be thoroughly trusted, and for whose services proprietors and agents eagerly compete, comparatively so few? Moral principle has not been strong enough to enable men to resist temptations to which a solitary life, distant from social amenities and religious restraints and privileges, has added force. Comfort is found in stimulants; the man "takes to drink"; that leads to habits and

associations which deprive the victim of his own self-respect and the respect of even the coolies it is his business to command. Rapidly or gradually the depths of degradation are reached, and the once bright youth is a broken-down loafer, mooning about, talking of his having been unfortunate, and that in Ceylon people are "down on a poor chap" who has not been "lucky." We will not fill in the details of a picture but too familiar to many of our readers. The waifs and strays of the planting community—who find asylums at the expense of their fellows—are to be heard of, if not seen, in most large districts (some are shipped off by subscription), and if you listen to their story and believe it, you will lay at the door of *misfortune* what owed its origin simply to fault—to moral infirmity. Our readers will not misunderstand us as making an assertion more sweeping than we intend it to be: we are talking only of a *percentage*, though a serious one. But to be a good coffee planter it is not enough that a man should have a good constitution and industrious habits, with the power of controlling his appetites. He must have at commencing, or acquire as he goes on, a fair acquaintance with many branches of general knowledge and especially natural science. It is not necessary that the coffee planter should be learned in the classical languages or fluent in the modern tongues, but certainly a facility in acquiring languages is of importance. The manager of a coffee estate in Ceylon, to be thoroughly useful and successful, ought to be well up in colloquial Tamil, at least. Mr. Sabonadière attributes his own good relations with his coolies to his ability to communicate with them directly by a fluent use of their own language. We know what the prejudices against the "middleman" are amongst races far higher in the scale of civilization than the coolies. We cannot wonder, therefore, at the great advantage possessed by the superintendent, who, without descending a step to anything that is degrading in the native level, is able wth precision to convey his directions to the workmen in their own language, and perfectly to understand the reports, written or oral, of his kanganies (overseers of gangs), and the representation of coolies who may consider themselves aggrieved. To be a good superintendent, a man, then, must be a bit of a philologist. He must have a knowledge of law at least so far as the relations of master and servant are concerned, and the relations of the planters with thes owner of trespassing cattle. He ought to be well up in sanitary science, especially "the philosophy of smells." Mr. Tytler, of Dum-

bara, indulges largely in a species of pride which we should wish to see generally prevalent. This gentleman will take visitors over his numerous sets of lines and defy them to "*feel* a smell" (as the Scotch, with strict accuracy, put it). The planter ought to know and act on the conviction that, while nothing is so deadly as dirt in the wrong place, nothing is more useful in the right place. Bone, dust and ashes are just like "line manure": dirt. Each requires to be properly manipulated and utilized instead of being allowed to run to waste or worse. But not only must the European superintendent of a coffee plantation know how to combat the propensities of a race, whose best friends do not claim for them the merit of cleanliness,—he must not only know how to convert dirt from a source of disease into a source of fertility, but he must know at least enough of the principles of medicine and surgery contained in the Medical Hints which have been prepared for his use, to be able to treat or guide the treatment of disease and ordinary accident amongst his laborers. Even in the healthiest districts, fevers and bowel diseases will occur, coolies will cut their fingers or toes and get bitten by noxious reptiles. The superintendent must be ready to treat simple cases, and have intelligence enough to know where cases are beyond his control, and conscience enough to give such cases at once the benefit of those splendid and well-regulated hospitals at Gampola and elsewhere—so palatial in their beauty and airiness that we can imagine patients feigning sickness in order to remain in them. [We shall not soon forget the favourable impression resulting from a visit to that truly magnificent hospital which the Government of Ceylon has provided, mainly for the treatment of coolies, at Gampola. Mr. Keyt keeps it so, that the only odour possibly perceptible is that of the flowers in the neat garden plots.] But it is in natural and chemical science that the planter must specially possess, and be ever acquiring, knowledge. Acquaintance with the principles of geology and mineralogy will enable the planter to form a fair idea of the soil he is called to work on. A knowledge of its constituents will enable him to judge what the soil requires for the continued and healthy growth of a plant over severely pruned and handled into yielding the maximum of a most exhausting crop. [Big words, such as geology and mineralogy, ought not to frighten any planter. The well-known planter who "hangs out" somewhere below Hunasgiriya

peak, and who tells the Planters' Association that "chocklat" coloured soil, when friable, is good for coffee and amenable to manure, is a geologist and mineralogist in his practical way, though he may not be able to classify the rock or name its main constituents.] But to know what the requisite applications should be, and how the applications should be made, the planter, above all, perhaps, should have a competent knowledge of the science which Liebig and Johnson and Voelcker and others have so greatly advanced in our day—agricultural chemistry. If able to try a few simple experiments, so as to test soils, but especially to enable him to judge of the quality of fertilizers imported and sent to the estate, so much the better. Bone dust may be impure or almost inert, and even superphosphates may differ most materially in percentages of fertilizing qualities—just as spirits vary in the degrees of alcohol they contain. But there must be no slavish adherence to the results of mere analysis. Substances poor in fertilizing properties may yet be eminently useful from their mechanical and chemical effect in warming and disintegrating soil naturally stiff and poor. If we judge merely by Liebig's analysis of the coarse lemon-grass mana, which covers such vast savannahs in the hill country of Ceylon, we should contemptuously dismiss it as valueless. Its ashes yield only 3 per cent of potash and 2 of chloride of potassa, against 81½ of silica (the latter the substance of which glass is made and which gives the straw of wheat and other corns and grasses its strong and shining covering). What help, therefore, can so wretchedly poor a substance yield to the planter? Just this, that if it could be procured in sufficient quantity within a reasonable distance, so as to render its application possible at a moderate expense, a complete thatching of it would probably warm the stiff cold clays of Ambagamuwa and set free their fertilizing ingredients for the growth of coffee crops: crops which would compete with those gathered in Dimbula at its best. The application of phosphates to the warmed and loosened soil could be usefully and remuneratively made. What we here incidentally notice is well worthy the serious attention of planters. If grass for thatching soil cannot be procured great benefit might be obtained by a similar use of other substances not likely to leave seeds of weeds or injurious insects behind them. Mr. Sabonadière's experience has led him to the decided conviction that to all the other good effects of an application of mana grass is to be added the eradication of the "bug" blight from

coffee plants. It is now nearly fourteen years since Mr. Wall (in a paper which we trust he will soon republish, corrected and expanded as the result of extended experience) drew attention to the application of mana grass and the result in extirpating weeds on free soils, and, in additon, largely promoting (indeed creating) fertility in the case of cold stiff soils. We quote as follows:—

"MANA GRASS is most useful, both as bedding for cattle and a litter to be applied on the surface of the soil. When used for the former purpose, its chief advantages are its abundance, and the facility with which it may be cut and carried; for the latter purpose I have employed it very extensively, and with widely different results. When applied to free soils that abound in vegetable matter, as those of Hunasgiriya, it is scarcely of any use except to keep down weeds or to kill running grass; but on the cold, wet soil of Ambagamuwa, its effect is almost magical, exceeding that of a heavy dose of cattle-manure. I have applied it to a cold, heavy, yellow soil, in which coffee bushes could scarcely exist, and where their scraggy branches had only a few small yellow leaves on them, and the effect was most surprising. Not only were the trees soon clothed with fine dark green foliage, but even the soil appeared to be changed, and, to the depth of three or four inches, became friable and dry. How this change was accomplished, whether by the acids resulting from the decomposition of the grass, or by the protection afforded to the soil, I do not pretend to say, but I can speak confidently to the fact.

"EFFECT.—The increase of crop obtained through the agency of this manure, in the instance above alluded to, was at least five hundredweights per acre.

"COST.—The cost of this method of manuring is much less felt on a weedy estate than on a clean one, because on the former it almost supersedes the necessity for weeding. The principal item of cost is the carriage of the grass. I have, therefore, restricted the use of mana grass to places within one hundred trees of the spot where the grass is grown. Under this system the cost of a heavy littering, in which each tree has a very heavy cooly-load of grass, is 35s. per acre. One such heavy littering, and two light ones of about 20s. per acre each, are sufficient for a year, that is, about 75s. per acre per annum for weeding and manuring. I am of opinion, that, after two or three years of this treatment, the land would be able to bear several successive crops without requiring the assistance of litter.

"The effect of surface littering is much increased

by the digging up of the soil, previous to the application of the mana grass."

Mr. Sabonadière, writing more than thirteen years after the above was published, shews how, when buried in trenches, mana grass is beneficial to *any* soil; the trench system, we may remark, obviating the one great danger of fire which attaches to the over-ground application. Besides incidental notices, Mr. Sabonadière writes in the chapter devoted to manuring:—

"MANA GRASS must be buried in trenches cut longitudinally across the face of the hill; the trees not only benefit from the decaying grass, but from the loosening of the soil. The benefit is most marked; and all patena lands planted with coffee should be treated in this manner. Mana grass has also a wonderful effect in improving poor coffee, when applied as a thick thatch to the soil six to nine inches deep. It thus not only prevents the growth of weeds and stops wash, but the decaying grass seems to give freshness to the soil; the trees make wood fast and bear heavily. Thatching the ground as above is a successful cure for the black bug; this I can vouch for from personal experience; the cost is considerable, but the results quite justify the outlay."

This instance will shew what scope the planting enterprise presents for the intelligent and discriminating application of the laws of agricultural chemistry to substances within more or less easy reach of the planter as well as to imported fertilizers. But Mr. Sabonadière's book shews us also how important it is that a planter should be botanist and horticulturist enough to have a fair acquaintance with the laws of vegetable life, so as usefully to guide the operations of topping, pruning, handling, and even manuring. Entomology, too, must be studied, so as to enable the planter to have an intelligent knowledge of the history and habits of such "enemies of the coffee" as grub and bug. Then the planter must be a bit of an architect, so as to judge of the fitness for his purposes of the excellent plan and elevations for bungalows, stores, and pulping-houses, which Mr. Sabonadière's book supplies; and he must be a very good bit indeed of a mechanical engineer to do justice to water-power (perhaps steam) machinery in the shape of wheels, pulpers, &c. Hydraulic science will claim much attention and pneumatics some, for, whether a "Clerihew" is set up or not, there must be floors of coir, or wire netting, through which the pulped and washed coffee can get fresh air to carry off damp and prevent fermentation. A knowledge of common mortar and of cements and asphaltes, and of the best mode of applying them, is useful. But it is difficult

to say what knowledge of science and the arts would *not* be useful to the coffee planter: perhaps above all he ought to be a good financier, for it is clear that a coffee estate of 200 acres cannot be brought into cultivation (say in four years) at a less expenditure than from £25 to £30 an acre—from £5,000 to £6,000 in all after allowing for the proceeds of some crop in the close of the period. That fact must be faced, and borrowing as much as possible avoided. How to obtain money is about the only thing which Mr. Sabonadière does not teach. On most of the other subjects we have indicated, his book will greatly aid the neophyte planter; while experience (short or long according to the man's own intelligence and industry) will do the rest. We meant to enter more into details, but the reflections which a perusal of the work and our own experience and observation have forced on us must suffice for to-day. We hope to have something more to say in our next issue with reference to the useful book which forms the subject of remarks already more extended than we contemplated. But the enterprise of which it treats is of paramount importance to Ceylon, and with the return of peace we trust this enterprise will become still more important, and a good deal more profitable than it has lately been to those engaged in it.

Second Notice.

To justify our statement that to be a coffee planter it is necessary that a man should be possessed of knowledge varied and comprehensive, we have but to quote the headings of the chapters into which Mr. Sabonadière's book is divided:—

"Introductory Remarks, Selection of Land, Soil, Elevation, &c.; Felling, Clearing, and Lopping, Nursery, Lining, Holing, and Planting; Roads and Drains; Weeding, Topping, Pruning, and Handling; Manuring, Trenching, &c.; Picking, Curing, and Despatching Crop; Bungalows and Lines; Stores, Pulping House, and Barbacues; Tools and Machinery; the Enemies of the Coffee Tree; the Malabar Cooly; Estimates."

The great feature in the present edition is an entirely new chapter on Manuring, which embodies the large experience the author has obtained in the use of artificial manures applied to the extensive properties under his charge. Mr. Sabonadière's experience has led him thoroughly to believe in the vast benefits of judicious manuring when combined with draining and trenching, and we know that he traces the short crops of the present season to meteorological influences and not to manuring, although, of course, harm has been done and can be done by the ill-advised

use of forcing manures. It has now been effectually proved, he states, that

"Draining to prevent wash and waste of soil, and a system of manuring while the trees are still young and vigorous, tend to prolong the age of estates. There is no doubt that under such a system coffee trees may have as long an existence as other evergreens; excepting of course such contingencies as overbearing, attacks of grubs, the tap root coming in contact with rock, or becoming rotten from swampy soil, all of which bring the tree to premature decay."

Mr. Sabonadière, like every one else, gives the preference to cattle dung where it can be plentifully and economically applied. Of course the mere opening of so large a hole as is usually dug near the coffee trees would effect much good even if no manures were applied. But as the expense of applying large quantities of so bulky and heavy a material as cow-dung is very great, it may be important to our planting readers to know that a gentleman with considerable experience in the use of manures has found that a much smaller quantity than is ordinarily used of cow-dung or pulp will have all the effect of the larger quantity if mixed with a proportion of bone-dust, or, better still, superphosphate. Manuring with cattle-dung, aided by bone-dust or artificial manure, Mr. Sabonadière believes could be so managed that, with an average expenditure of £3 per acre per annum, "properties of even medium soil might be kept to an average bearing rate of eight to ten cwts. an acre, which would fully repay the cost, and leave a large profit besides." As Mr. Sabonadière is speaking of cases where the cattle are wholly stall-fed, this judgment founded on his experience is most important as showing that where capital and skill are applied to the coffee enterprise that enterprise can be rendered profitable, not merely temporarily but permanently. But clearly here, as in all other pursuits, skill must be supplemented by capital. There can be no doubt that much of the failure we have to mourn over in Ceylon has been due to the mistake of attempting too much. Men have cleared and planted 200 to 400 acres of land, when they ought to have concentrated their energies and means on 100. Mr Sabonadière is, of course, in favour of burying all the prunings. If labor cannot be spared for so necessary an operation as this, the look out is a bad one. We quoted notices of mana grass in our last, but there are many properties where this substance cannot be procured within available distance. In those cases a reserve of forest would be valuable, from which fresh earth could be brought to be applied with manure; also twigs to be

buried in trenches or to be burnt into ashes, while the larger branches could be converted into charcoal. Purchasers of lots in Dimbula, which are high and close to forest, not likely ever to be felled for coffee planting purposes, have their compensating advantages in the direction we have indicated. Some of their young plants may be gnawed by rats from the forest, and there may be some tendency to bug from nearness to damp and shade, but it is an immense advantage to be close to inexhaustible reserves of humus and potash. With these from the neighbouring forest, the pulp and prunings of the estates, some cow-dung and a small quantity of good bone-dust or really rich superphosphate, we have little doubt that properties at from 4,300 to 5,000 feet above the sea can be kept at an average yield of 7 or 8 cwts. an acre. This, in a climate far superior to that of England, ought to content reasonable men. When sceptics point to the earlier Dimbula estates opened at a high elevation, estates which bore largely for the first few years of their existence and then went back, it must be remembered that such properties were opened in the pre-manuring era, while portions of them, revived by high cultivation, are again yielding heavy and remunerative crops. Mr. Sabonadière enters fully into the nature and value of composts made of poonac, bone-dust, and guano, the latter, a substance which should never be used except in combination with others, such as poonac. Of Leechman's compost, the author speaks as "A capital manure: one pound a tree is a proper quantity to be used, and the average cost including application is, say, £6 an acre. It may also be beneficially mixed with other manures. On this estate it was very effective in supporting trees under heavy bearing."

Of Sombreorum, Mr. Sabonadière's experience does not seem to have been large, but it is favourable as regards the very cases where manuring is most required, those of "poor coffee." We quote the paragraph:—"Sombreorum is one of the artificial manures that has lately been manufactured, and owes its origin to Mr. R. B. Tytler of Palakelle. As opinion varies much on its virtues, I have included in the Appendix some correspondence that has appeared in the newspapers upon the subject. My own experience of Sombreorum is that it is a good manure; but having tried it on very good coffee, the effects were not so perceptible as would have been the case on a poor estate. I have seen it applied to very poor coffee with most beneficial effects, but I fancy it requires to be frequently applied to afford lasting and remunerative results."

The cost of the leading manures and composts, including application, is given; but for the detailed figures we refer to the work. One result is clear: in addition to £25 to £30 an acre, which (including buildings) an estate of 200 acres will cost by the time it is brought into full bearing, an annual expenditure of from £1 10s. to £3 10s. an acre should be calculated on for trenching and manuring. Trenching, closed and open, is described, as well as modes of loosening the soil, applying swampy soil, &c. But we have dwelt long enough, though not too long, on this important subject of manuring, the great question on which the prosperity and permanency of coffee estates depend. Knowing the large direct benefits derived from a complete system of paths and cart roads through an estate (as well as the indirect benefits from the loosening of the soil in making them), Mr. Sabonadière strongly advises the thorough roading of a property as one of the earliest operations, and he is doubtless right, although even the sacrifice of coffee bushes on old estates is as nothing compared with the benefits compared by paths and cart roads for which they are sacrificed. In glancing over the book some curious facts strike us. In ordinary farming, cost of seed is an important and ever-recurring item. In the case of coffee-planting, the quantity and cost are, we should say, the smallest that can possibly occur. Five bushels of parchment coffee at the most will be sufficient for a nursery yielding plants for 100 acres. So that the equivalent of less than 2 cwts. of clean coffee, value say £6, would suffice to yield plants for an average estate of 200 acres. In the estimates we see that the cost of plants is taken at £100 for 200 acres in one case, at £45 for 100 acres in the other, or 6s. per thousand. We believe the cost of good plants in Dimbula is now 8s. per thousand. But, even taking grubs and the necessity of supplies into account, the cost of plants is about the smallest item of all. In sugar planting and other planting pursuits, the case is very different. The instructions for lining, holing, and planting are full and precise. The importance of keeping estates clean from the first is shewn by the astounding fact mentioned by Mr. Sabonadière, that if weeding costs 3s. per acre per annum, then the sum expended on only 800 estates was £288,000 annually. Now the sum cannot be under £300,000, an average of £300 for each estate. The prevailing weed, as our readers are aware, is the goat weed (*ageratum conyzoides*), which unfortunately feeds on the very elements required by the coffee plant for its healthy existence. Botanists, who ought to know, tell us it is not indigenous, but

introduced, like the thistle in Australia, and likely equally to demand special legislation for its control if not its extirpation. Much might be done, we suspect, by the application of some powerful chemical substance to gathered heaps of the *ageratum*. Burning cannot often from the dampness of the climate be so effectually accomplished as to destroy the amazing quantities of seeds which this plague of a weed produces. Mr. Sabonadière favours contract weeding under proper regulations. When he comes to pruning, the author expresses his belief (contrary to the general practice) that, if young trees were allowed to bear their maiden crop before being topped, it would be very much to their future benefit and endurance. He certainly gives good reasons for his belief and against the too early forcing of the trees for the sake of crop. We fancy that the greater or less exposure to wind will determine the practice. In Dimbula we suppose it would be safe to let plants grow to four feet high before topping, while in Medamahanuwara such plants would be blown to shreds or uprooted. Mr. Sabonadière must have been thinking of the women's right theory when, in regard to pruning, he wrote:—"Even *women* may be taught to use the knife in a very *workmanlike* manner." In treating of picking there is an application of common sense which seems too obvious to be mentioned, and yet the vast majority of young planters would require to learn from experience what Mr. Sabonadière thus describes:—

"In steep ground, my orders invariably were to pick from the top of the hill. My reasons were, that if any coffee dropped, it rolled down forwards and was more likely to be seen and picked up, and because the coolies were not loaded when near the top of the field, so they had not to come down to empty their small bags and then have to go up again—perhaps to finish only a few trees—which they are very loth to do, their natural object being to complete their task as quickly as possible."

The value of such an appliance as spouting on an estate is presented vividly in the following extract:—

"Where there is a sufficient declivity and a sufficiency of water, spouting should be made use of to transmit the cherry to the pulping house from distant parts of the estate. Along the lines of spouting, here and there, in convenient spots where paths converge receiving houses must be put up, into which the coffee is taken and spouted down to the works. The coolies, being thus enabled to deliver their loads near at hand, are not only spared the toil and labour of a long and, in wet weather, sometimes a dangerous journey to the pulping house, but time, which is always money,

is saved; the coolies are able to gather a larger quantity, and they are saved bodily wear and tear. With a force of 200 coolies in the field, an increase of at least 100 bushels, or 10 cwts. a day may be safely reckoned upon, amounting say to 300 cwts. for the five heavy weeks of picking, and representing a money value of fully £1,002 in the London market."

Under the head of bungalows and lines, Mr. Sabonadière argues strongly for permanent buildings of stone with shingled roots. Very valuable plans and estimates are given from which we gather that, even in so remote and expensive a district as Udapussellawa, buildings can be erected at about the following prices:—

"STORE.—Stone pillars, roof of galvanized Morewood's tiles, sawn timber, coir-matting floors in three stories, £485.

"PULPING HOUSE.—Solid masonry, pillars, and cisterns; a double floor for curing purposes, corrugated iron roof, but not including cost of machinery £483.

"BUNGALOW.—Outside walls of stone, inner walls, sawn timber, mudded between sawn reapers, planked floors, and shingle roof, and including £70, as cost of godowns, £356.

"The levelling of the sites has not been included."

A first-class bungalow for a married European gentleman with a family would cost £500. The cost of lines is, strangely, omitted, but to provide for a property of 200 acres in full bearing, we suppose the following figures would be pretty near the mark:—

Store	... £500
Pulping-house	... 500
Bungalow for proprietor or chief supdt.	... 500
Do. for "Sinna Durai" ...	... 300
Lines (say)	... 500
	Total...£2,300

This must be near the mark, for one of the estates gives £2,530 for buildings and machinery, including £250 for spouting. Less than £2,000, it is evident, will not suffice for really good buildings, or at the rate of £10 per acre, leaving £15 to £20 per acre for planting, roads, drains, &c. We need scarcely remark how much the use is facilitated, and the cost lessened, of imported machinery, iron roofs, spouting, &c., by the railway and extension of cart roads. The planters of the present generation may have to pay higher for labor and materials of local production, but they have nevertheless great advantages as compared with their predecessors, those for instance who had to employ elephants to carry heavy machinery up the Kandy road.

In looking over the valuable matter in the Appendix, we are struck with some curious results arrived at by further experience. Mr. Wall wrote on manuring some fourteen years ago. Time has confirmed (as we shewed in our last issue) his estimate of the value of mana grass; but it has completely overset what he wrote about coffee pulp. All he could say of pulp was that it was not "very valuable or very effective, but it costs nothing or next to nothing." In the experience of others it has proved of immense value, even alone; but certainly most beneficial when mixed either with cattle dung, bones, or superphosphates. Mr. L. St. G. Carey considers pulp and superphosphate about the best possible application to coffee; while in Mr. Sabonadière's estimation, pulp mixed with cattle dung, is equal in value to the cattle dung itself. But can extended use alone, in the face of such large exports, have led to the great rise in the cost of bones? Mr. Wall stated the cost of bones in 1857 at 3s. 6d. per cwt. (£3 15s. per ton!) in Colombo or 6s. on the estate. Taking 5 cwts. as the quantity for an acre, about 45s. per acre would suffice for cost on estate and applying. Mr. Sabonadière is moderate when he calculates the cost of a ton of steamed bone dust at Colombo now at £8 10s. or £10 on the estate. He would apply half a ton at a cost of 17s. 6d. or £6 2s. 6d. per acre in all. The half of this would be 61/3 against Mr. Wall's 45/; the cost of bones in Colombo having thus more than doubled; the cost of carriage to the estate being reduced from £2 10s. to £2 per ton; while the cost of applying has risen from 14s. 8d., say 15s., to 17s. 6d. Allowing for the additional cost of grinding and steaming, the great fact is that bones in Colombo cost now considerably more than double what they could be procured for in 1857. Even so, if of good quality, they are well worth the money, and recent experience points not to their disuse, but to their judicious use.

Third Notice.

Enemies of the Coffee Tree.

The note of alarm sounded by a correspondent today gives a new interest to anything referring to the ravages of "grub" on coffee estates and the remedies proposed. In Dimbula, where large expanses of patanas alternate with forest, we can scarcely be surprised that black and white grub (the larvæ of moths and cockchafers) should abound and should be destructive to young coffee as well as to cultivated plants of every kind. We have already stated in these columns that on many young estates in Dimbula fifty per cent of

the plants were destroyed in the first year by grubs, which ringed off the bark close to the ground. But our information went to shew that, as the trees increased in age and vigour, the attacks of the grubs became of less importance, and that the planters on the whole made light of the prospect of permanent danger from these pests. Like bug-blight and buffalo trespass, they would have their day, but would cease to attract attention as good markets for coffee enabled planters to cultivate highly and to build fences, cut ditches, or station watchers. But this alarm from one of our older districts demands, and doubtless will receive, serious attention. Happily Ceylon is not much troubled with the "borer" so frightfully destructive in Southern India, but, so long ago as 1861, Mr. Nietner characterized the larvæ of the moth, known to naturalists by the title of AGROTIS *segetum*, as "the well-known and very destructive black bug;" while in regard to white bug "ANCYLONYCHA *Spec.*" he wrote:—"Under the name of 'white grub,' the larvæ of various melolonthidæ do much harm to coffee plantations, young and old, by eating the roots of the trees." Lime put into the holes with the young trees was mentioned as a remedy, and Mr. Nietner expressed surprise that the ashes of the recently burned forest had not a deterrent effect. With the light of all further experience, here is Mr. Sabonadière's deliverance on the subject:—

"With coffee-planters, as with English farmers, there is seldom a season when everything goes right. Thus, if the crop is a good one, there are not sufficient coolies to pick it; or, when there is a short crop, there are so many hands that one is puzzled how to employ them. At other times, scarcity and dearness of rice, exorbitant cart hire, excess of rain or drought:—all more or less tend to make the planter anything but a contented man.

"In addition to the drawbacks enumerated above, the coffee-tree suffers from the attacks of various creatures of the animal and insect kingdoms. In its youth coffee is attacked by large grubs, which eat round the bark of the plants just above the ground, so that the stems break and the plants generally die off. Ashes and limes are sometimes spread round the tree in hopes of averting this evil, but with no very great success. I am inclined to think that coal tar applied to the stem would be more efficacious in stopping the ravages of these insects, which are particularly destructive at the lower elevations, where the soil is light, dry, and quartzy."

We fancy that even in such elevated districts as Dimbula, grub, like bug, chiefly affects low, swampy

parts of estates. At any rate, after the first year, grubs are found only on parts of estates, and draining with high cultivation would probably be the best remedy in such cases. Coal-tar cannot but be useful in the case of grub, as well as bug, if judiciously used. A story was afloat in Dimbula, when we last visited the district, of a planter having destroyed not the grub but a number of coffee bushes, the stems of which he had painted with tar. If the case occurred, the dose of tar must have been an over-dose. Messrs. Worms were wont to put tar on about two inches of the stems of their trees, with the effect of driving away bug and without injury to the painted trees. But, for eradicating grub, we should think the coal-tar should rather be buried near the tree—say in a limited circular trough round the stem. But, instead of using coal-tar in this way, we should think that the almost universal remedy, carbolic acid, would answer. As sold by the chemists, this spirit of tar will bear a solution of 80 times its bulk of water before it can be safely sprinkled on trees infested with bug or other insects. But we should think that as a mixture with cow-dung or other manure, or to be placed direct in holes near trees, a much greater strength would be safe—a strength which would rapidly destroy every form of "poochee" (insect) life by asphyxia or combustion, while no harm would happen to the roots of the coffee tree. Experiment would soon settle the quantity of carbolic acid to be used. In applying it, the planter would have the satisfaction of knowing that he was, while destroying insect life, using the best possible means of increasing the chances for health and life of the human beings and cattle on his estate, carbolic acid being about the best-known agent for destroying the germs of epidemic disease, such as cholera and cattle murrain. If, as seems certain, thatching of ground with mana grass is destructive to bug (query from the evolution of an acid ?) we should think it would be equally inimical to grub. At any rate wisps of mana or other grasses, saturated in carbolic acid, buried near grub-infested trees, could not but be effective. These are our suggestions, submitted for the consideration and comment of practical and experienced planters. There must be much valuable information in planting circles on this subject. In view of the alarming letter we publish, we should be glad to be reassured. Are we right in hoping that the grub pest, like that of bug, is merely temporary, partial, and not largely destructive ; or is it about to scatter ruin over the coffee districts of Ceylon, similar to that which the borer has carried through Coorg and other portions of Southern India ?

Fourth Notice.

We would just cull a few further facts from Mr. Sabonadière's volume. "Native" coffee bushes of great age are scattered all over the country, but they grow under conditions different to a great extent from those which exist on regular plantations. On the oldest formed plantations in British times, however, bushes more than forty years old still exist and still produce coffee. The best average distance for coffee bushes is six feet square, which will give 1,200 to the acre; while 18 inches square is the size of hole most commonly approved of, and the holes can be advantageously left open for some time before being planted. Plants for the nursery should be carried out in baskets, their roots covered with wet moss. The drying up of the small fibrous roots is supposed to be the great cause of failures. In going over the book we find the following further reference to bug:—

"During the dry weather, in February, March, and April, young plants in many districts suffer from the attacks of a very large grub, which eats the bark in a circle just above the ground; and the flow of the sap being thus stopped, the trees droop and die. Estates with a light reddish or quartzy soil suffer more than those where rocks and stones are plentiful."

Another quotation is as follows:—

"Drains, like roads and paths, should be cut as soon as the estate is commenced, or at all events before the trees cover the ground, or the same causes will obtain with reference to damage being caused to coffee trees. These drains must be about fifteen inches wide and deep, at the distance of every fifteen to twenty trees—*i. e.* 120 feet apart; the gradient should not be more than from one foot in ten to one foot in fifteen. These drains should be directed into the natural ravines, and these may also with advantage be cleared of obstacles, such as logs and large stones, so as to open out the water-way."

Large pits for the drains to empty soil in will, of course, be most useful. Contract weeding, carefully regulated, is the best. Fruit trees should be planted round estate bungalows.

ESTIMATES.

We (compiler of "Handbook") add two other 'Estimates' from distinct sources to that of Mr. Brown's, in order to shew the great differences between the views of different planters. The first is one of those given by Mr. Sabonadière in his "COFFEE PLANTER OF CEYLON":—

No. 2.—Estimate for the bringing into Coffee Cultivation 200 acres of Forest Land.

Filst Year: 1 *Sept.* 186— *to* 31 *August* 186—.

	£	s.	d.
Purchase of 300 acres of forest land—say at £1 per acre	300	0	0
Government survey fees	50	0	0
Felling, lopping, burning, clearing, cutting pegs, lining, and holing (6 by 5), at £5 per acre; 100 acres	500	0	0
Filling-in holes, planting, and supplying; 100 acres, at £1 per acre	100	0	0
Purchase of 150,000 plants for planting and supplying, at 6s. per thousand... ..	45	0	0
Making nursery and purchase of seed ...	10	0	0
Stone pillar and shingle lines, 60 by 20...	70	0	0
Superintendent's bungalow	300	0	0
Conductor's bungalow	30	0	0
Loss on rice	50	0	0
Purchase of tools	30	0	0
Roads, 3 miles	45	0	0
Weeding 100 acres, from March 1 to August 31; 6 months, at 2s. per acre per month..	60	0	0
Superintendent	100	0	0
Conductor	50	0	0
Contingencies	50	0	0
General transport	50	0	0
	£1,840	0	0

Second Year: 1 *Sept.* 186— *to* 31 *August* 186—.

	£	s.	d.
Felling, lopping, burning, clearing, cutting pegs, lining and holing; 100 acres, at £5 per acre...	500	0	0
Filling-in holes, planting, and supplying, at £1 per acre	100	0	0
Making nurseries and purchase of seed...	10	0	0
Stone pillar, one set, and shingle lines, 60 by 20	70	0	0
Roads, 3 miles	45	0	0
Planting grass	30	0	0
Weeding, 1st clearing for 12 months, at 2s.	120	0	0
,, 2nd ,, 6 ,, ,,	60	0	0
Loss on rice	70	0	0
Purchase of tools	10	0	0
Superintendence	150	0	0
Conductor	50	0	0
Contingencies	50	0	0
General transport	50	0	0
	£3,155	0	0

THIRD YEAR : 1 *Sept.* 186— to 31 *August* 186—.

		£	s.	d.
Superintendence		200	0	0
Conductor		50	0	0
Weeding 100 acres, at 2s. 6d.		150	0	0
,, at 2s.		120	0	0
Handling		30	0	0
Draining 200 acres, at 15s...		150	0	0
Stone pillar and shingle lines		70	0	0
Roads, 3 miles, at £15 ...	£45 0 0			
Cart-roads	200 0 0			
		245	0	0
Pulping-house, store, purchase and putting up of machinery		1,000	0	0
Iron coffee-spouting		300	0	0
Purchase of tools		20	0	0
Loss on rice		100	0	0
Contingencies		50	0	0
General transport		50	0	0
Picking, pulping, and drying 400 cwt. off 100 acres, viz. 4 cwt. at 6s.		120	0	0
Transport to Colombo, 1,900 bushels, at 1s. per bushel		95	0	0
Colombo charges: curing, 4s. 6d.; export duty, 1s. per cwt.* = 5s. 6d.		110	0	0
Total expenditure		£6,015	0	0
Loss: 3 years' loss of exchange on £6,015, at 6 per cent.		360	0	0
Total expenditure		£6,375	0	0
Less, net value of 400 cwt. in London, at 67s. per cwt.		1,340	0	0
Estate Dr.		£5,035	0	0

Note.—The superintendence in this estimate is calculated as if the property was opened by the manager of an adjoining estate.

[It is interesting to note where the chief discrepancies exist between Mr. Brown and Mr. Sabonadière's correspondent. The latter clearly goes in for more expensive buildings and a greater amount of work altogether. At the same time it must be remembered that, with £5,000 to the debit, 200 acres have been opened in the above; while Mr. Brown is £1,320 to the debit with 100 acres opened, his estate being worth £5,000. In Mr. Sabonadière's case the estate ought to be worth £10,000. The following estimate, which appeared in our last Handbook, has been

* No export duty now.—COMPILER.

compiled in Southern India, but it will be found to corroborate Mr. Brown's lower rates. Indeed we have the most positive assurance of strict economy, under favourable circumstances, securing the opening of a coffee estate and bringing it into bearing at rates varying from £12 to £15 an acre. This, of course, could only be done by working with one's own capital, and opening carefully and energetically.—COMPILER.]

We (*South of India Observer*) have received the following Estimate from a correspondent who assures us that it is based on actual experience:—

ESTIMATE for bringing 200 acres of Forest Land into bearing, opening 100 acres in the 1st, and 50 acres in the 2nd and 3rd years; supposing that a block of 300 acres has been purchased at R30 per acre.

	1st Year.	2nd Year.	3rd Year.	4th Year.	5th Year.
	Rs.	Rs.	Rs.	Rs.	Rs.
Tools	600	100	75	100	300
Nurseries and Plants ...	1,500	100	100	...	...
Bungalow and Furniture	1,000	50	50	3,000	100
Lines	500	50	50	2,500	120
Felling and Clearing ...	2,000	1,000	1,000	...	...
Lining, Pitting and Filling in	3,000	1,500	1,500	...	...
Planting	400	200	200	...	..
Roads	1,000	600	600	100	150
Drains	500	300	300	50	150
Weeding	1,000	1,700	2,300	2,600	2,400
Store and Pulping House	...	...	3,000	4,000	100
Loss on Advances ...	200	50	100	100	100
Loss on Grain. ...	500	300	300	400	600
Land Tax	...	...	200	300	400
Superintendence ...	3,000	3,000	3,600	3,600	4,800
Supplying	...	200	150	50	100
Contingencies	1,500	915	1,352	1,680	932
Interest on cost of Land	900	900	900	900	900
Do. Outlay	460	1,155	1,823	2,700	3,465
Total...	18,060	12,120	17,600	22,080	14,617

Total...R82,477=£8,247 14s.

The cost of the land has been taken at R30 per acre. This may seem high, but it is a question whether good forest land with a sound title can be had now in Wynaad even at that rate.

The "year" of the estate is supposed to commence in September.

I.—The allowance for tools will be found sufficient, if decent care is taken of them.

II.—It is generally necessary to purchase plants for the first year's clearing—allowance has therefore been made for the cost of 120,000 at R10 per 1,000.

III.—*Bungalow.*—An allowance has been made for the erection of a good temporary house and office, as well as for the purchase of necessary furniture in the estimate for the first year. The allowance in the fourth year is for the building of a good sawn timber bungalow.

It would be better to commence the permanent buildings in the second and third, instead of in the third and fourth, years. Such a cou se, however, although very desirable, is not always practicable.

IV.—The cost of roads will depend greatly on the lay of the land, whether many or comparatively few are required.

V.—The loss on advances can only be estimated approximately. With good management and luck, it should not exceed the amount estimated.

VI.—The loss on grain is also merely an approximate estimate. It has been a very serious item lately, but the prospects of the coming grain crops are now good; and raghy, &c., should be cheap before long.

VII.—*Superintendence.*—This item provides for Agency, if required, but in the event of there being no Agent, due allowance has been made for a good superintendent—a man content to wait for an increase of pay until the estate can afford it.

VIII.—For store and pulping house R7,000 have been allowed, and this sum should pay for a water-wheel if the works are judiciously arranged.

IX.—*Contingencies.*—These have been calculated at 10 per cent. on the total expenditure. It will be observed that loss on grain and advances have been taken separately.

X.—*Interest.*—This has been calculated at the rate of five per cent. per annum.

Crop expenses calculated at Rupees 100 *per ton.*

3rd year's crop:—

Maiden crop off 100 acres=20 tons; value on the coast, less expenses, say		R10,000
4th year:—		
Maiden crop off 50 acres=10 tons Good do. ,, 100 ,, =40 ,,	Value, less expenses	25,000
5th year:—		
Maiden crop off 50 acres=10 tons Good do. ,, 50 ,, =20 ,, Full do. ,, 100 ,, =40 ,,	Value, less expenses.	40,000
By interest for 2 years at 5 ₩ cent. on R10,000=R1,000		R75,000
By interest for 1 year — on R25,000=R1,250		2,250
		R77,250

South Wynaad, 27th April, 1867.

MANURING COFFEE ESTATES.

(From the *Ceylon Observer*, 5th April 1871.)

The most interesting topic discussed in this connection of late has been the effect of manures on old estates, and, in addition to several other communications, we have received to-day the following valuable expression of opinion from a very competent authority :—

KANDY, 4th April.

DEAR SIR,—Although not one of the shining lights whose opinion has been specially solicited by you on the all-important question of manuring old estates, still as one who has spent some £15,000, and a greater portion of his time during the last three years, on artificial manures, peradventure you will permit me space for a few remarks thereon.

I am 'a man under authority,' having excellent superintendents to whom I have only to say: 'Put Sombreorum here or Bones and Poonac there, so many ounces to a tree, and it is done—and with all the punctuality and care which those most interested could desire. The board placed by the wayside indicates the nature of the application and date thereof. For the first year our work was purely experimental; we wasted much money and gained much valuable knowledge—if I am right, as I believe I am, that the result has been a system of cultivation by which we can renovate many of the exhausted properties, while we preserve the younger estates from premature decay, you will agree with me the experience has been cheaply purchased.

In all these experiments it is but right to say I have had the valuable assistance of the most intelligent estate managers, men whose apathy towards the P. A. is much to be regretted, because there one might expect such subjects to be ventilated; but what can any Chairman do if unsupported by the experience and intellect of the various districts?

We do not go to Yakdessa to learn planting, and it is quite as absurd to expect the Chairman of the P. A. to enlighten us on cultivation. Much less do I presume to come before you with an Essay on Manuring. My time is not my own—any more than the results of the manure. I merely wish to state, briefly but emphatically, that old estates can be renovated, and that artificial manures do pay. Who among us on re-visiting our native land have not seen the black moor, where erstwhile our grandfathers dug their praties, now transformed into rich fields of waving corn, and by what? Simply by artificial manures; and if such results can be obtained in such a

climate from such uncompromising materials what might not be done here in one of the best climates in the world?

If a man cannot keep an average estate in this country in a remunerative condition, he simply shews he knows no more of cultivation than his grandmother.

I deprecate the tendency in this country to whine over every little difficulty. A disappointed man finds his crop short, and, without thinking whether the cause be climatic or otherwise, puts it down to his hap-hazard manuring, and exclaims at once, What 's the use of manure?

Another cross-grained individual finds a spotted leaf which he croaks over and magnifies, until he bursts before the world as a great authority on "leaf disease."

That there are a great number of estates too far gone to be profitably renovated, I am but to sensible of: one needs only to travel in the lower districts to see this. It is lamentable indeed to watch how tenaciously the planter will stick to his weeding and manuring long after the dry sticks have ceased to give the slightest hope—better for himself, much better for his agents, that his energies were transferred to Borella. But this is no reason why an average estate favourably situated should not be kept in a remunerative state for all time coming.

I shall give three instances out of many where I have found manures to pay:—

No. 1.—An estate of 200 acres, altitude 3,000 feet, steep and rocky, ten years old, had given two very heavy crops, afterwards a crop every alternate year which was killing the coffee out at the rate of 5 per cent per annum, barely paying expenses. Every tree was manured with artificial manures, partly with Sombreorum, but chiefly bones and poonac; crop of last year 7 cwt. per acre. This year 8 cwt., condition of trees very much improved, and not 1 per cent dead. Yearly profit £2,000.

No. 2.—An estate of 300 acres, altitude 4,000 feet, soil somewhat stiff, easy undulations, "a beautiful sheet of coffee," but stems of trees "hide-bound," and the wiry little branches inclined to form crows' nests, average crop 3 cwt. per acre, which left a dead loss. Manured two years ago; crop this year 6 cwt. per acre, character ot wood wonderfully improved. Profit £1,200.

No. 3.—An old estate probably 35 years planted, partially abandoned for several years, crops reduced to 2 cwt. per acre, leaving a loss of £1,200 per annum. Large portions reclaimed from lantana and manured chiefly with poonac (which it is but right to say in this case we improved by passing through the cattle).

Crops of this year 6 cwt. per acre, which leaves a profit of £1,500.

I find the following average results from manuring *good* coffee:—

CATTLE MANURE costing £12 per acre gave 4 cwt. per acre increase for 3 years.

BONE DUST costing £8 gave 4½ cwt. per acre first year, 2 second.

BONES AND POONAC costing £8 10s. per acre, 4 cwt. for 2 years.

SOMBREORUM costing £4 10s. 3 to 4 cwt. (somewhat uncertain).

ANIMAL REFUSE £8, gave 2 to 4 cwt. do.

PHOSPHORIC POTASH costing £3 5s., nil.

COMPOST costing £6 improved the foliage for 6 months.

I am, dear sir, yours faithfully,

AGRICULTURIST.

MANURING.

(From the *Ceylon Observer*, 22nd April 1871.)

20th April 1871.

DEAR SIR,—The appearance of the second edition of Mr. Sabonadière's Planting Manual is very apropos at a time when some authoritative statement relative to manuring seems to be desiderated. The new chapter added on this subject is as full as it can be. No dogmatic rule can be laid down that will apply generally; facts can be stated and recommendations made; but, beyond this, circumstances so vary, that practical managers alone must decide what is best for each individual case.

Cattle dung is the only fertilizer that can be universally applied with success.

All others must be guardedly used according to local circumstances, taking into consideration soil, climate, age, and condition of the trees.

Guano is rightly discarded, or nearly so, from the list of manures. To it can be attributed much of the disappointment of early manuring, and many of the desolate fields one sees. It may be serviceable at great elevations in small quantities, but it is unsafe. At this time of day it should be needless to remark that the freer from weeds a property is, and all estates now being opened should be kept perfectly clean, the more benefit will the trees derive from manuring, because they will not be robbed. When there are weeds, they should, with prunings, leaves, &c., be collected and utilized by a system of compost

dépôts at distances that it will pay to carry all to. This would remove the objection so common that heavy composts can be applied only close to roads. In addition to weeds and prunings, compost heaps can be formed wherever there is patana land, as in some districts, and swamps. These must not be applied crude and sour, but after thorough manipulation and always with the addition say of half a pound of bones, or half that quantity of Sombreorum or other highly concentrated preparations.

When patanas adjoin an estate it is customary to have cattle sheds at different points. When both estate and native cattle are housed, the natives will bring their cattle in considerable numbers for a small payment per head; thus one stone can be made to kill two birds, make valuable manure and alleviate cattle trespass. It is advisable always to put a small quantity of some artificial manure with all cattle dung and composts, it makes them go further and improves the latter. The approved modes of application are different in new and old coffee; the first has not suffered from wash and is easy work. A hole to each tree is better than one to four, the semicircular nine inches by four, above the tree, or what I have seen answer remarkably well in a shallow hole all round the tree and close to the stem. In this mode of application great care is necessary that none of the large roots are cut. The manure, well mixed with soil, is applied immediately over these. Manuring old coffee is as difficult work as new coffee is easy. In old washed places where tons upon tons of the soil have gone to fertilize Neptune's garden and the trees stand out of the ground as boys grown out of their trowsers, it is not an easy matter to place the manure where the trees can get it. Where stones are plentiful it is a good plan, and not very expensive, to build a small terrace to every tree, and then the manure well mixed, with the best soil procurable out of the holes usually dug for the manure above the trees, is shaken in among the roots and all well covered, the holes left open as an open trench, and the sediment collecting in them should be put round the tree every time they are cleared out. Where stones are not procurable, the best must be done with the soil alone.

Much of the disappointment arising from manuring not realizing expectations is caused first from the use of over-stimulants; and secondly, the trees being allowed to over-bear without further timely aid being afforded them. How often one hears the remark: Such and such a manure put a splendid crop on that field but did not ripen it. A manager knows when trees have more crop than they can ripen, or just

ripen, thoroughly exhausted, and it should be in his power to help them.

Thatching is good if it can be kept up, not otherwise. And I should rather advise, that all vegetable substances be made into compost and applied as recommended above.

Yours faithfully, P. M.

HOW TO BUILD A CHIMNEY FOR A HILL BUNGALOW.

[WRITTEN EXPRESSLY FOR THE BENEFIT OF CEYLON COFFEE PLANTERS, BY A PRACTICAL PHILOSOPHER.]

What a comfort it is, on a wet night, up in the hills, to sit down and toast your shins, at a fine blazing fire ; and how tormenting it is to find as one often does that, with the comfort of the fire, you must also put up with the discomfort of smoke.

The number of ingenious dodges which the builders of chimneys on coffee estates have adopted for judiciously mingling the bitter with the sweet in this matter is truly astonishing. A very common dodge is to make a narrow entrance with sharp shoulders, to catch a sufficiency of smoke as it enters the chimney, and bring it out into the room. Another is to contract the vent to the narrowest possible passage, say to a four-inch pipe, where one four times as large or eight inches is needed. Another is to make pigeonholes at the top not more than half the size needed. Sometimes you find the fire away back at the far end of a long archway, and looking into the vista, the glare of flame is seen steaming up the vent far away, conveying a vague impression of warmth, while at the same time the wonderful arch is so constructed that the roof slopes *downward* toward the fire, and at the far end juts into the current of smoke, catching the necessary quantum which eddies up the slope somewhat reluctantly into the room. A skilful combination of two or more of these is not uncommon. For the benefit of those who would prefer a cheerful fire without the "soor reek," it may be good news to learn, that there is no more mystery about the requisites of a good chimney, than there is about the requirements of a water channel. A vent is simply a conduit for smoke, and its requirements are very much the same as a conduit for any other fluid. To understand it aright, one common error about chimneys must be got quit of, and that is "THE DRAFT." Smoke, like other air, may be *pushed*, but can't be *drawn*. You may draw a bucketful of water, but

the rope draws the bucket, not the water, the bucket *pushes* the water all round and below. So you may draw a bucket of air, by the bucket *pushing* it, not otherwise. Smoke is lighter than common air, so the air gives the bigger (heavier) push, and pushes the smoke upwards. The hotter the smoke is, it is the lighter, consequently the greater the difference between it and the air, and so the push of the air is so much greater, and the smoke must move off faster. It is to be noted, however, how very small this push is. Suppose you have a chimney a square foot in vent and twenty-two feet high, and the fire heated the smoke in it, till it expanded one-tenth more than the air outside. Then the twenty-two feet of smoke in the chimney would be only equal in weight (suppose smoke same weight as air, which it is not) to twenty feet of air: consequently there is equal to the weight of two feet of air less pressure inside than outside the chimney. Hence, if the bottom of the chimney is open to the air, the smoke is forced upwards by a pressure equal to the weight of two feet of air, an amount hardly to be detected by the finest aneroid. If heat be increased till the volume of smoke be increased to a fifth more, there would be nearly four feet of extra pressure outside. So if the chimney be doubled in height, and the heat maintained so as to increase the smoke by one-tenth throughout, we would have four feet of pressure extra outside, and the smoke be pushed upwards with correspondingly quickened speed. It is, however, a very small pressure at that. A windgauge would shew a very small amount of pressure and speed at a chimney top. Therefore, this *small* pressure must be *carefully utilized*. With pressure enough plenty of air might be driven through an inch pipe to supply a smelting furnace, and the smoke of an ordinary fire through a tobacco pipe, but to secure such a speed the pressure must be many atmospheres, not a few feet or inches of air. When we kindle a fire in the fire-place, we have then smoke (which is heated air, and bits of coal, &c.) pushed up gently by the heavier air around in a continuous current. To allow it to get up at the speed such small force causes, there must be *room* enough, say from 80 to 140 square inches (*i.e.* 8×10 to 12×12) of a vent. The straighter and smoother the vent, the easier the passage, just as in flowing water. All bends should be easy, and no sudden contractions, no jutting corners. To secure this, perhaps the best thing would be to make a block or frame the requisite size, and make the mason build round it, drawing it up as he raises his building, thus securing a free and equal passage all the

way up. So much for the vent. A very important matter, however, is its mouth or entrance. When it is desired to direct the flow of a wide stream into a narrow channel, the channel is made *wide* at the mouth and *gradually* narrowing to the narrow channel. So, to direct the current of smoke into the narrow vent, the mouth of the vent must widen, so as to enclose all the smoke, and *gradually* narrow. All sharp shoulders must be avoided. The vent must be like an inverted funnel, or like a helmet hat, with the crown elongated and open to form the vent. There is no advantage gained, and much heat lost, by having the chimney and fire far back into the wall. If the front edge of the funnel rim (or hat brim) comes far enough forward to catch *all* the smoke, no more is needed. If the lintel of the fire-place were the chop of an old pulper, its edge forming the rim of the funnel, and the vent gradually narrowing from that upwards, one foot and a half would be far enough back for the wall behind, and the fire would thus give out plenty of heat, and all the smoke go up the vent.

Suppose the dimensions as follows :—

Fire-place, width $2\frac{1}{2}$ feet, from back to front $1\frac{1}{2}$ foot, height of lintel 3 feet, chimney vent 80 inches square, or 10×8.

Fire-place, width 2 feet 9 inches, back to front 1 foot 8 inches, height of lintel 3 feet 6 inches, chimney vent 120 inches, or 12×10.

The fire-place should be so constructed that the air may get freely *under the centre* of the fire, but not *behind* it, otherwise the current rushing in behind fills up the chimney, and forces the smoke forward, and out into the room. A very simple way of avoiding this is to make the bars reach only half-way back, closing up the space behind, or, if bricks only are used, leaving an open hole, say the space of a brick, half-way, *i.e.*, nine inches in from the front. The current of air thus getting in below the fire, and being directed upwards through its centre, carries the smoke upwards and backwards safely into the vent.

Another thing of importance is the chimney-top: if there were no wind or rain, it would only be necessary to leave it open the same width as the chimney. As there is wind, however, and that generally so very much stronger in current than the current of smoke, as to be able to stop it, and turn it back, it must be guarded against. Where the wind is blowing *level* there is little difficulty. A little contraction at the top, such as the pressure, &c., will bear, may give speed to the smoke current, to push through the horizontal wind current. Where the wind current

slopes downwards however, as it does where the house is on the side of a hill, over which the wind is blowing; or even if the house be on the edge of a precipice, down which the current sweeps,—of course the wind will blow slanting downwards into the upper mouth of the vent; and, if it is at all strong, will easily send down the current of smoke. To avoid this, a sufficient protection is needed at the top. Pigeon-holes—as one is always (and two often) turned to the wind, and so wind allowed to enter, which may go down, or at best occupy the opposite hole for egress—are not good in any difficult case. The simplest and best in ordinary circumstances is an iron pipe, say of 9 inches diameter, with a pyramidal cover fixed over it, sufficiently high and wide to allow of the easy exit of the smoke, and reaching far enough down to keep the downward slanting wind from getting into the pipe. In very bad situations, an "old wife" may be necessary, *i.e.*, a movable bent tube over the other tube, the mouth of the bent tube turned to one side, and, by the aid of a vane, kept turned from the wind. Or better still a "sailor's hat," *i.e.* a pyramidal cover like the first-mentioned, but, instead of being fixed, turning on a universal ball joint in the apex. Either of these has the advantage of keeping out the current that would blow down the vent, and also another advantage which will be noticed hereafter. The only other source of annoyance requiring to be noticed is the interruption, by any cause, of the pressure of the external air. At home where doors and windows are so close as to allow scarcely any opening for air to enter, the greater part of the few feet of extra pressure of the air without is expended, in forcing the requisite current of air into the room through the key-hole, and sending it whistling through other chinks and crannies, so that often not enough pressure is left to carry up the smoke. The opening of a door, or window, or other hole to carry the air below the fire, is the easy remedy. In this country where all is so open no such cause operates. But an interruption may also be caused by an eddy. If we put a board into a swift running stream, and hold it firm with the end on the bottom and its breadth across the current, it will be found that the water, although it bends in its current round the edges of the board to fill the space behind it, yet does not stand so deep behind the board as elsewhere. If the current be strong and the water say a foot deep generally, behind the board it will be only 9, or 8, or 6 inches, according to the force of the current. So with a stone, even when the water flows over it. Behind the board or stone where the eddy is, there

is only the pressure of 9 or 6 inches on the bottom, while elsewhere there is a foot. Now an eddy in the same way may take place with the wind, blowing over and past a house, and though, as air is an expansive fluid, it does not leave a vacancy entirely, still the pressure of the air that is in the eddy is lessened in proportion to the force of the current. Now if the door or window through which the pressure is applied and the current flows, to carry up the smoke, should happen to be in such an eddy, the pressure might be greatly lessened, even to the extent of entirely counteracting the effect of the lesser pressure in the chimney, and causing a current in the opposite direction, *i.e.*, down the chimney and *out* at the door or window, or the effect of the eddy is often easily detectable by an aneroid or barometer. Of course the only remedy is to close that door or window, and open one somewhere else. The shape and construction of the "old wife" and "sailor's hat" forms of chimney-tops gives them the advantage of this eddy, in removing by so much the pressure of air at the top of the chimney and thereby increasing the force of the current up the chimney.

Such are a few facts and philosophies which may be useful, let it be hoped, in producing fire and warmth without smoke.

P.S.—In building a fire-place, two objects are to be kept in view. Allowing the heat to come out into the room and the smoke to escape up the chimney. To effect the first, openness is required, the latter closeness. A convenient compromise may be made by making the back and sides of the fire-place of the same width as the chimney, or only a very little wider at the back and contracting gradually into it. The sides of the same width as the sides of the chimney, so that the whole forms as it were a continuation of the chimney with the front wanting. From the line of the front the sides widen out on a slope as much as possible to allow the heat to radiate through the room. The advantage of this is that the air only gets the opportunity of rising with the smoke on one side, *i.e.*, the front, and thus the volume of smoke is not increased, and what is is kept at the back and must go up the chimney.

☞ The publisher appends some papers which have previously seen the light in the *Observer* and elsewhere, and which contain information of special service to planters :—

ASPHALTE FLOORING.

(From the *Overland Observer*, 30th April 1863.)

A correspondent sends us a paper containing "Notes upon the Laying of Asphalte Floors," which he has no doubt will be interesting and useful to many in Ceylon :—

The first requisite in laying down asphalte flooring is a boiler, made of either cast or malleable iron. Any size may do, but the larger it is, the greater will be the surface covered at one melting, and the fewer, therefore, the joints or seams upon the finished floor. The tools required are—a light malleable iron stirrer, for mixing the sand and bitumen in the boiler ; a few sheet iron cans with which to carry the melted material from the boiler to the floor ; a strong sheet-iron ladle, for filling it into the cans ; a few iron or wooden straight-edges, to form the boundary of the asphalte flag when being laid ; a narrow wooden spreader for spreading out the asphalte when poured upon the broken metal ; and two or three wooden rubbers (something like plasterers' floats) for rubbing up the surface of the flag as it cools and hardens.

In commencing an asphalte floor, the first thing is to satisfy yourself the bottom is firm. If it is not, then ram it well down before laying on the broken road metal. Next, if the metal itself is not carefully beat over the surface, no care afterwards will ever make good asphalte out of it. The stones must lie pretty close, and the surface be made level and even.

For cart or any other sort of heavy traffic, double coat work is absolutely necessary, and may be proceeded with as follows :—Dig out the ground to within four inches of what is to form the surface of the finished floor. Spread in from three to three and-a-half inches of broken metal, and ram it slightly and evenly over the surface. Metal composed of one to one-and-a-half inch stones, and free from dirt or sand, forms the best floor. Smooth boulders or pebbles never do so well. Have a boilerful of soft bitumen prepared, and, when thoroughly melted, add about half its own weight of thoroughly dried sand or fine gravel, and stir well, till all be intimately mixed. This half-gravelled stuff won't be very viscid, and must be ladled, therefore, into asphalte cans that won't leak, and poured from thence into the broken metal, one canful after another, till it fills up all the interstices, and nearly flushes the stones. Ram all well down as the

asphalte cools, so as to consolidate the structure as much as possible.

Melt another boilerful of medium bitumen, if for inside work, or soft, if for outside, and when melted add fully its own weight of dried sand. Stir well while doing so, and the produce will be a thick viscid mass. Lay down your straight-edges upon the under coat (now perfectly hard), so as to enclose such a space as the contents of the boiler are likely to cover. Ladle these contents into the cans, and empty them smartly, beginning from one corner across the floor; spread evenly, about three-fourths of an inch thick; and, when one strip is finished, begin again at the first, ere it has time to harden. This upper coat will incorporate thoroughly with the one below, and so will each canful with its predecessor. Dust the surface immediately with a mixture of ground chalk or dried whitening and finely-sifted sand; or, if the floor be wished rough, use coarsely-sifted sand alone. As the asphalte cools, clap and rub up the surface, so as to expel air-bubbles and remove wrinkles, and render all firm and smooth. As it hardens, rub still more firmly and rapidly.

When the asphalte flag is broad, a plank must be laid across it about six inches from the surface, upon which one of the assistants can go upon his knees and rub it over everywhere.

Single-coated asphalte may do for barn floors and other places subjected to the common wear and tear of foot traffic.

The under-coat of asphalte is thus dispensed with. Medium bitumen is used if for inside work—soft, if for outside; and when melted it is mixed with its own weight of dried sand, stirred well, and spread out upon the broken metal, which may be an inch shallower than in the case of double-coated work. Part of the asphalte sinks among the stones, and binds them well together, but the greater part remains on the surface, and may be spread about three-fourths of an inch thick, and dusted and rubbed up same as in double-coated work.

The irons should be placed straight on the broken metal, levelled carefully, and fixed firmly down. A smart stroke will bring them away when the flag has cooled, and then it will present a clean and square edge, against which a second flag may be laid, and will adhere closely. The seams or joints may be softened either by a chauffer or a red hot-iron held over it (but not in contact), dusted with the chalk, pared carefully with the edge of the rubber, and pressed and vigorously rubbed, after which the joining will scarcely be seen, Before laying one flag against an-

other, brush the joint clean, and see you press the hot asphalte well into the edge of the cold flag.

The straight-edges should be three-fourths of an inch thick, and are better made of malleable or cast-iron. The cast iron ones are generally bevelled on the one side, so as to form the edge of channels when turned upside down. Wooden straight-edges will do, if rubbed over with chalk or clay, to prevent the asphalte adhering to them. In making a channel in the asphalte, the bottom must be first laid three-fourths of an inch below the finished surface. When cool, the bevelled irons can then be laid upon it upside down, and the floor proceeded with as usual.

Stir the bitumen occasionally while melting to prevent it burning, or clinkering to the bottom of the boiler; and see you prevent any great amount of rain from getting in, or the contents may chance to boil over. When the asphalte is about to be laid down, see that it is hot enough, and the cans and ladle well heated before the fire. In emptying the cans, scrape them out every time, or they will get crusted up, and carry almost nothing.

In all cases where there is to be much traffic, such as at doors or door-steps, it is a good rule always to lay the asphalte a little thicker than over the rest of the floor—perhaps even to double-coat a square yard or two there. You will do well to paint all iron-work and the edges of door-steps and other parts to which you wish the asphalte to adhere firmly with black varnish. When the varnish dries, the asphalte will stick far more firmly to the stone or iron-work.

For kitchen floor, bakehouses, smithy-shops, and other floors where there is to be always much heat, hard bitumen should be used, and made stiff with gravel, and spread hot. 70 cwt. of bitumen will do 100 square yards of good single, and 90 cwt. the same extent of double asphalte. The blocks of bitumen weigh about 2 cwt. each. A cubic yard of broken metal should serve 14 to 15 square yards of single, and 12 to 13 yards of double asphalte work.

Pitch oil is used to soften the bitumen when too hard for the sort of work intended. It is added slowly to the mixture in the boiler immediately after the sand. In forming roads for cart traffic, a larger addition of this pitch oil is absolutely requisite. The metal should be dry and free from dirt, and spread three to four inches thick with a slight rise from side to centre. This is grouted full of hot half-gravelled asphalte—the stones left appearing on the surface so as to catch the horses' feet. The surface should be well sanded, and firmly rammed as it cools. Where the cart traffic is great, a second coarse of this grouted metal is often necessary.

MR. TYTLER ON FASTENINGS FOR IRON ROOFING.

November 1858.

The Secretary, Planters' Association.

SIR,—When Columbus made the egg stand on end on the table, how simple the matter appeared to his audience. There is many an idea as simple, but of far more utility. I had a store covered with corrugated iron in an exposed situation. If the sheets of this iron were fastened down at both ends, the simple principle of expansion and contraction of the iron by the alternating degrees of heat and cold very soon loosened the nails or rivets and the sheets became loose. The manager of the estate was annoyed beyond endurance by the blowing off by the wind of his store roof, and in his desperation he screwed them to the rafters. The result was, one blowy night, the rafters and all were lifted off.

John Gordon, the pulper-maker, conceived the idea of rivetting slips of iron, to one end of each sheet of iron, into which he slipped the end of the overlapping sheet, nailing the other end to the rafter or reaper, and the other end being loose slid up or down within the slip according as the iron contracted or expanded, and thus he kept his iron firm and secure. Recently, on an emergency, I had to cover a store with iron. I could find none of Gordon's iron, but only plain sheets. In my dilemma I mentioned the difficulty to a gentleman in Kandy, who tore off the cover of a Price Current, and shewed me how by pieces of stiff hoop iron bent in three to slip over the end of the upper sheet, and under that of the lower sheet, I might answer the purpose. So I procured these from Walker & Co., and nailing the upper ends of the sheets to the rafters, and holding the lower end of the next overlapping sheets by means of these slips, the roof is all I could desire. The corrugation of the iron admits of expansion across the sheet, while the lateral expansion and contraction work up and down the hoop-iron slips, and the nails are not loosened, nor the roof impaired.

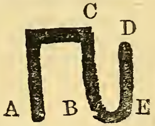
In gratitude to the friend who gave me the idea, I communicate this intelligence to my fellow planters through you, not doubting that there may be some who will be as thankful as I am to know how to get over a difficulty, serious in itself and in so very simple, inexpensive, and rational a manner.

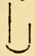
Yours very truly,
R. B. TYTLER,
Chairman.

CORRUGATED IRON ROOFING.

(From *Ferguson's Ceylon Directory*, 1872.)

The following piece of useful information from a practical planter has been lying by us for a considerable time. In working up papers connected with our Handbook it comes before us again, and doubtless the suggestion will still be useful to many planters. Our correspondent writes :—"In your Useful Memoranda (see page 79), under the heading of "Corrugated Iron Roofing," you say the sheets should be double rivetted; now rivetting spoils the iron for after use, *i.e.*, some of the rivets generally refuse to come out from rust, hence in removing the iron that part will tear. Now, to prevent this, there is a better plan which I think ought to be in your useful book; it is this: instead of the rivet use a clip



something like the above. The space from B to A going over, round, and under the reeper upon which the iron is laid, the top of the first sheet of iron goes under the part of the clip B C, and the bottom of the second row of iron slips into the part D E. On the lower side A the clip ought to have a small nail into the reeper; for the first row of the iron the clip ought to be  merely, as it holds only the one by the above methods. By the simply removing of your ridging, you can take off your roofing without injury to a single sheet; ¾ inch good hoop iron is the best size for the clips=two clips for each sheet :

Clip No. 1.

No. 2.

HOW TO MEASURE SAWN TIMBER.

Rakwana, 27th July 1871.

The prevailing practice in this district in the measuring of sawn timber is to measure the *breadth only* of all planking under 2 inches thickness; over 2 inches, the breadth and thickness ought to be measured. In the case of reepers from 2 to 3 inches broad width,

measurement is the rule, but when a large number of them are required, the better plan is to arrange for them by the 100. Sawyers prefer the cutting of reepers to anything else, and will take them at a lower rate per 100 than breadth measurement, when not mixed up with heavy scantling, such as beams, pillars, and joists, which use up a number of trees for very little sawing. The rate at which sawyers are paid here is 12/ per 100 feet, except for the cutting of jak, when 15/ has to be paid.

AREA OF LAND.

(From the *Queenslander*.)

To aid farmers in arriving at accuracy in estimating the area of land in different fields under cultivation, the following table is given :—

5	yards wide	by	968	long	contains	one acre.
10	,,	,,	484	,,	,,	,,
20	,,	,,	242	,,	,,	,,
40	,,	,,	121	,,	,,	,,
70	,,	,,	69½	,,	,,	,,
80	,,	,,	60½	,,	,,	,,
60	feet wide	by	726	feet long	contains	one acre.
110	,,	,,	396	,,	,,	,,
120	,,	,,	363	,,	,,	,,
220	,,	,,	198	,,	,,	,,
240	,,	,,	181½	,,	,,	,,
440	,,	,,	99	,,	,,	,,

FOREIGN WEIGHTS AND MEASURES REFERRING TO COFFEE, &c.

Brazil Sack=161·9 lb. or 1$\frac{3}{7}$ cwt.
1,000,000 sacks=1,450,000 cwt.
500,000 do.= 725,100 do.
1,000 do.= 1,450 do.

Brazil Arroba=32·3817 lb. or about $\frac{2}{7}$ of a cwt.
[5 arrobas of 32 lb. each say=1 bag=160 lb.]
100 arrobas=nearly 29 cwt.
10,000 do. =2890⅓ cwt.

Java Picul=133⅓ lb, or (for purposes of rough estimation) nearly 1$\frac{1}{5}$ of a cwt.
1,000,000 piculs=1,181,500 cwt.

Dutch Pond is 2$\frac{1}{5}$ lb. or $\frac{1}{50}$ of a cwt.

French Kilogramme is 2$\frac{1}{5}$ lb. or $\frac{1}{50}$ of a cwt.

From our Directory we take useful hints worthy of repetition here :—

FROM "MOLESWORTH'S POCKET-BOOK OF ENGINEERING FORMULÆ."

[Extracted by permission of the Author.]

ASPHALTE FLOORING.

8 lb. of asphalte composition will cover 1 sup. foot, $\frac{3}{4}$ inch thick.

CORRUGATED IRON ROOFING.

B. Wire Gauge.	Size of Sheets.	Weight per square.			Sq. feet per ton.
	Feet.	cwt.	qrs.	lb.	
No. 16...	6 × 2 to 8 × 3	1	0	14	800
18...	6 × 2 to 8 × 3	1	1	6	1000
20...	6 × 2 to 8 × 3	1	3	6	1250
22...	6 × 2 to 7 × $2\frac{1}{2}$	1	2	7	1550
24...	6 × 2 to 7 × $2\frac{1}{2}$	1	0	24	1880
26...	6 × 2 to 7 × $2\frac{1}{2}$	1	0	6	2170

1-10th of the weight to be added for lappage.

Sheets should overlap about 6 inches, and be double rivetted at joints.

3 lbs. of rivets required per square of roofing.

Purlins should be 6 feet apart.

Curved roofs may be made up to 20 feet span without framing; tie-rods 12 feet apart.

SOUND.

Velocity of sound in air ...= 1,142 ft. per [second.

Ditto	,,	water = 4,900	,,
Ditto	,,	iron =17,500	,,
Ditto	,,	copper=10,378	,,
Ditto	,,	wood =12,000 to 16,000	,,

Distance sounds may be heard on a still day:

Human voice.........	150 yards.
Rifle.....................	5,300 ,,
Military band	5,200 ,,
Cannon	35,000 ,,

HEAT.

Conducting power of substances, slate being 1000.

Slate	1000	Fire-brick	620
Lead	5210	Chalk	564
Flagstone	1110	Asphalte	451
Portland stone..	750	Oak	336
Brick...............	600 to 730	Lath and plaster	255
		Cement	200

GLUE TO RESIST MOISTURE.

1 lb. of glue melted in 2 quarts of skimmed milk.

When strong glue is required add powdered chalk to common glue.

GLUE CEMENT TO RESIST MOISTURE.

1 glue
1 black rosin
$\frac{1}{4}$ red ochre
} mixed with the least possible quantity of water.

OR

4 of glue.
1 of boiled oil by weight.
1 oxide of iron.

ADMIRALTY KNOT=6080 FEET.

Marine paddle-engines generally work up to 3 times nominal horse-power; screw engines (direct action) to 4 times.

WATER POWER.

Theoretical horse-power of water:

Q=Quantity of water, in cube feet, per minute.

h=Head of water from tail-race, in feet.

HP=Theoretical horse power.

HP=.00189 Q h.

$$Q=\frac{528\ HP}{h}$$

Effective horse-power for different motors:

Theoretical power being................	=1.00
Undershot water-wheels	= .35
Poncelet's undershot water-wheels	= .60
Breast wheel..............................	= .55
High-breast	= .60
Overshot wheel	= .68
Turbine	= .70
Hydraulic ram rising water.........	= .60
Water-pressure engine..............	= .80

MEMORANDA CONNECTED WITH WATER.

1 cubic foot of water=62.4 lb.

1 cubic inch ....=.036 lb.

1 gallon ....=10 lb.

or.....................=0.16 cube feet.

1 cube foot of water =6.2355 gallons.

or, approximately=$6\frac{1}{4}$,,

1 cwt. of water......=1.8 cube ft.=11.2 gals.

1 ton of water.......=35.9 cube ft.=224 ,,

Pressure of water per sq. inch at different heads:

P=Pressure in lb. per square inch.

H=Head of water, in feet.

P=H × .4333.

H=P × 2.31.

Pressure per square foot=H 62.4.

Cubic feet of water × 0.557=cwt. approximately.

,, ,, × 0.028=tons ,,

1 cube foot of sea water...=64.14 lb.

Weight of sea water=weight of fresh water × 1·028.

TO MEASURE HEIGHTS WITH THE SEXTANT.

Multiplier.	Angle.	Divisor.	Angle.
	°		
1	45 0	1	45 0
2	63 26	2	26 34
3	71 34	3	18 26
4	75 58	4	14 2
5	78 41	5	11 19
6	80 32	6	9 28
8	82 52	8	7 8
10	84 17	10	5 43

Set the sextant to any angle in the table, and the height will equal the distance multiplied or divided, as the case may be by the number opposite to it.

RAINFALL.

Inches of rain-fall ⋈ 2,323,200 = cube feet per square mile.
" " ⋈ $14\frac{1}{2}$ = millions of gals. per ditto.
" " ⋈ 3630 = cube feet per acre.

HINTS ON THE CONSTRUCTION OF CARRIAGE ROADS.

Ordinary turnpike roads, 30 feet wide, the centre 6 inches higher than the sides.
4 feet from the centre $\frac{1}{2}$ inch below the centre.
9 feet from the centre 2 " do. do.
15 feet from the centre 6 " do. do.
Footpaths 6 feet wide, inclined 1 inch towards the road.
Side drains 3 feet below the surface of the road.

Road Material: bottom layer gravel, burnt clay, or chalk, 8 inches deep. Top layer, broken granite not larger than $1\frac{1}{2}$ inch cube, 6 inches deep.

Footpaths—fine gravel, or sifted quarry chippings, 3 inches thick.

WEIGHT OF EARTHS, ROCKS, &c.

Weight of Cube yard of Sand about 30 Cwt.; Gravel do. 30 do; Mud do. 25 do; Marl do. 26 do; Clay do. 31 do; Chalk do. 36 do; Sandstone do. 39 do; Shale do. 40 do; Quartz do. 41 do; Granite do. 42 do; Trap do. 42 do; Slate do 43 do.

Mortar—1 of lime to 3 or $3\frac{1}{2}$ of sharp river sand.

Or, 1 of lime to 2 of sand and 1 of blacksmith's ashes or coarsely ground coke.

Coarse Mortar—1 of lime to 4 of coarse gravelly sand.

Concrete—1 of lime to 4 of gravel and 2 of sand.

Hydraulic Mortar—1 of the blue lias lime to $2\frac{1}{2}$ of burnt clay ground together.

Or, 1 of blue lias lime to 6 of sharp sand, 1 of puzzolana and 1 of calcined ironstone.

Beton—1 of hydraulic mortar to $1\frac{1}{2}$ of angular stones.

Cement—1 of sand to 1 of cement. If great tenacity is required the cement should be used without sand.

Waterproof Mastic Cement—1 of red lead to 5 of ground lime and 5 of sharp sand, mixed with boiled oil.

POTATO CULTURE IN NUWARA ELIYA.

(*Specially contributed.*)

The season for planting begins in March, and ends in September; very few people plant earlier or later because of the frost. Forest-land is the best, as it yields about twice as much as patana in general. The soil ought to be turned up one or two months (and longer if possible) before the potatoes are planted. Guano and cattle manures are most in use. The first yields the heaviest crop, the second is the cheapest, and some people think it lasts the longest: it is used by most farmers, especially by the natives. The land intended for the crop is dug over two or three times, and all roots and stones are removed; the drills are then cut about two feet apart, and the manure is then put in ready for planting. The potatoes from the Neilgherries, India, are preferred, though some plant seed they save from the first crop, from foreign potatoes, and now and again you see a crop of Australian and Bombay kinds. When everything is ready the potatoes are cut in pieces (such pieces ought to have two or more eyes) or planted whole, according to fancy, and planted out in the drills about one foot apart by Europeans, and about 8 inches apart by natives. They are then covered over with earth about 2 inches deep. Nothing is done to them after, until they begin to grow, when the black grubs generally cut them off, so people go round catching the latter. When the plants are about 4 inches high, they ought to be moulded up, and again when they are about 6 inches. Some people mould three times, but it requires care as the roots may be disturbed and so spoil the crop. The enemies of the potato farmer are, 1st, the black grub (mentioned above), which does the most harm during the first month.

2nd, the wind—it does the most harm during the months of May, June, July, August, and September.

3rd, the elk—they eat off the tops and tread down the ridges and are hurtful all the season.

4th, the pigs—they root up the potatoes and eat them; they do the most harm during the 3rd month.

5th, porcupines—do. do. do. do.

6th, rats— do. do. do. do.

7th, the frost—it does harm to the crops planted early or late if they are near water.

8th, the disease—it shews itself before the potatoes flower, and is the worst of all, as you can neither catch, frighten, nor destroy it. The crops are ripe at the end of the 3rd month,* when they are generally dug out, and if an acre was planted and gave a fair

* Some leave the crop in the ground two weeks longer.

crop, the yield would be from 40 to 50 cwt.* The quantity generally planted on an acre is 8 cwt.†

The following is about the cost of clearing and planting, &c. :—

1st Crop.

Forest.	£	s.	d.
To clear, fence, and turn up	20	0	0
10 cwt. manure if guano	10	0	0
8 cwt. seed at 45s.	18	0	0
Drilling and planting	2	0	0
Moulding and grubbing	1	10	0
Taking out	2	0	0
Total...	£53	10	0

Patana.			
To fence and turn up	15	0	0
12 cwt. manure guano	12	0	0
8 cwt. seed	18	0	0
Drilling and planting	2	0	0
Moulding and grubbing‡	1	12	0
Taking out	2	0	0
Total ..	£50	12	0

2nd Crop.

Forest or Patana.			
To turn up the land	2	0	0
10 cwt. manure guano	10	0	0
8 cwt. seed	18	0	0
Drilling and planting	2	0	0
Moulding and grubbing	1	10	0
Taking out	2	0	0
Total...	£35	10	0

If cattle manure is used, about £1 ought to be taken off the foregoing estimates. That is in case the manure is close to the garden and a native the owner.

The prices of potatoes range from 15s. to 30s. per cwt.

W. I. C.

N.B.—The drills are cut about 8 inches deep and about same width. Guano is generally put to the potatoes when they come up and before a shower of rain and the mould drawn to them at once.

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* Sometimes the whole crop fails, and the produce in cwts. is not equal to the quantity planted. And again we hear of some people who get enormous crops —I have only heard of two such, say of 60 or 65 cwts.

† A European will not use so many cwts. to the acre: about 7 cwts. would do unless the seed was very large.

‡ The reason patana costs more than forest land for grubbing is that there are more grubs in it.

...s ...ly.	Coolies per Acre.	@ 30 cents.	@ 31 ce...
	100	30·00	31·(
	50	15·00	15·5
)	$33\frac{1}{3}$	10·00	10·3
)	25	7·50	7·7
)	20	6·00	6·2
0	$16\frac{2}{3}$	5·00	5·1
0	$14\frac{2}{7}$	4·29	4·4
0	$12\frac{1}{2}$	3·75	3·8
0	$11\frac{1}{9}$	3·33	3·4
)0	10	3·00	3·1
)0	5	1·50	1·5
)0	$3\frac{1}{3}$	1·00	1·0
00	$2\frac{1}{2}$	0·75	0·7
00	2	0·60	0·6
			E
10	130	39·00	40·3
20	65	19·50	20·1
30	$43\frac{1}{3}$	13·00	13·4
40	$32\frac{1}{2}$	9·75	10·0
50	26	7·80	8·0
60	$21\frac{2}{3}$	6·50	6·7
70	$18\frac{1}{7}$	5·57	5·7
80	$16\frac{1}{4}$	4·87	5·0
90	$14\frac{1}{9}$	4·33	4·4
100	13	3·90	4·0
200	$6\frac{1}{2}$	1·95	2·0
300	$4\frac{1}{3}$	1·30	1·3
400	$3\frac{1}{4}$	0·97	1·0
500	$2\frac{3}{5}$	0·78	0·8
600	$2\frac{1}{6}$	0·65	0·6
650	2	0·60	0·6
			C
10	150	45·00	46·5
20	75	22·50	23·2
30	50	15·00	15·5

TREES $5\frac{1}{2} \times 6$ FEET.

MAN

Amount per Tree. Oz.	Amount ·30 Cw.
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

18·00	18·36
13·50	13·87
10·80	11·10
9·00	9·25
7·71	7·93
6·75	6·94
6·00	6·17
5·40	5·55
2·70	2·77
1·80	1·85
1·35	1·39
1·08	1·11
0·90	0·92
0·77	0·79
0·72	0·74

☞ We have had placed at our disposal the following tables compiled by a "planter," which, he thinks, will prove very useful to his brethren:—

TABLE OF COOLIES' PAY.

Days.	4d. 17 cts.	5d. 21 cts.	6d. 25 cts.	7d. 29 cts.	7½d. 31 cts.	8d. 33 cts.	8½d. 35 cts.	9d. 37 cts.
	R C	R C	R C	R C	R C	R C	R C	R C
½	0 08	0 10	0 12	0 15	0 16	0 17	0 18	0 19
1	0 17	0 21	0 25	0 29	0 31	0 33	0 35	0 37
2	0 33	0 42	0 50	0 58	0 62	0 67	0 71	0 75
3	0 50	0 62	0 75	0 87	0 94	1 00	1 06	1 12
4	0 67	0 83	1 00	1 17	1 25	1 33	1 42	1 50
5	0 83	1 04	1 25	1 46	1 56	1 67	1 77	1 87
6	1 00	1 25	1 50	1 75	1 87	2 00	2 12	2 25
7	1 17	1 46	1 75	2 04	2 19	2 33	2 48	2 62
8	1 33	1 67	2 00	2 33	2 50	2 67	2 83	3 00
9	1 50	1 87	2 25	2 62	2 81	3 00	3 19	3 37
10	1 67	2 08	2 50	2 92	3 12	3 33	3 54	3 75
11	1 83	2 29	2 75	3 21	3 44	3 67	3 89	4 12
12	2 00	2 50	3 00	3 50	3 75	4 00	4 25	4 50
13	2 17	2 71	3 25	3 79	4 06	4 33	4 60	4 87
14	2 33	2 92	3 50	4 08	4 37	4 67	4 96	5 25
15	2 50	3 12	3 75	4 37	4 69	5 00	5 31	5 62
16	2 67	3 33	4 00	4 67	5 00	5 33	5 67	6 00
17	2 83	3 54	4 25	4 96	5 31	5 67	6 02	6 37
18	3 00	3 75	4 50	5 25	5 62	6 00	6 37	6 75
19	3 17	3 95	4 75	5 54	5 94	6 33	0 73	7 12
20	3 33	4 17	5 00	5 83	6 25	6 67	7 08	7 50
21	3 50	4 37	5 25	6 12	6 56	7 00	7 44	7 87
22	3 67	4 58	5 50	6 42	6 87	7 33	7 79	8 25
23	3 83	4 79	5 75	6 71	7 19	7 67	8 15	8 62
24	4 00	5 00	6 00	7 00	7 50	8 00	8 50	9 00
25	4 17	5 21	6 25	7 29	7 81	8 33	8 85	9 37
26	4 33	5 42	6 50	7 58	8 12	8 67	9 21	9 75
27	4 50	5 62	6 75	7 87	8 44	9 00	9 56	10 12
28	4 67	5 83	7 00	8 17	8 75	9 33	9 92	10 50
29	4 83	6 04	7 25	8 46	9 06	9 67	10 27	10 87
30	5 00	6 25	7 50	8 75	9 37	10 00	10 62	11 25
31	5 17	6 46	7 75	9 04	9 69	10 33	10 98	11 62

Money Equivalents.

S.	D.	R.	C.
0	0¼	0	01
0	0½	0	02
0	0¾	0	03
0	1	0	04
0	2	0	08
0	3	0	12
0	4	0	17
0	5	0	21
0	6	0	25
0	7	0	29
0	8	0	33
0	9	0	37
0	10	0	42
0	11	0	46
1	0	0	50
1	1	0	54
1	2	0	58
1	3	0	62
1	4	0	67
1	5	0	71
1	6	0	75
1	7	0	79
1	8	0	83
1	9	0	87
1	10	0	92
1	11	0	96
2	0	1	00

KANGANIES' WAGES AT 1d.

Days.	R C	Days.	R C	Days.	R C	Days.	R C	Days.	R C
1	0 04	25	1 04	49	2 04	73	3 04	97	4 04
2	0 08	26	1 08	50	2 08	74	3 08	98	4 08
3	0 12	27	1 12	51	2 12	75	3 12	99	4 12
4	0 17	28	1 17	52	2 17	76	3 17	100	4 17
5	0 21	29	1 21	53	2 21	77	3 21	112	4 67
6	0 25	30	1 25	54	2 25	78	3 25	144	6 00
7	0 29	31	1 29	55	2 29	79	3 29	200	8 33
8	0 33	32	1 33	56	2 33	80	3 33	256	10 67
9	0 37	33	1 37	57	2 37	81	3 37	272	11 33
10	0 42	34	1 42	58	2 42	82	3 42	300	12 50
11	0 46	35	1 46	59	2 46	83	3 46	365	15 21
12	0 50	36	1 50	60	2 50	81	3 50	400	16 67
13	0 54	37	1 54	61	2 54	85	3 54	500	20 85
14	0 58	38	1 58	62	2 58	86	3 58	600	25 00
15	0 62	39	1 02	63	2 62	87	3.62	700	29 17
16	0 67	40	1 67	64	2 67	88	3 67	800	33 33
17	0 71	41	1 71	65	2 71	89	3 71	900	37 50
18	0 75	42	1 75	66	2 75	90	3 75	1000	41 67
19	0 79	43	1 79	67	2 79	91	3 79	2000	83 33
20	0 83	44	1 83	68	2 83	92	3 83	3000	125 00
21	0 87	45	1 87	69	2 87	93	3 87	4000	166 67
22	0 92	46	1 92	70	2 92	94	3 92	5000	208 33
23	0 96	47	1 96	71	2 96	95	3 96	6000	250 00
24	1 00	48	2 00	72	3 00	96	4 00	7000	291 67

If the rating be by Cents multiply the number of days by the Cents; and in the answer dot off the two right-hand figures, which will show the correct answer in Rupees and Cents.

Example 1.

What is the value of 375 days' labor at R0·37 per day,

Thus 375 days
Multiplied by 37 cents

Answer 13,875 cents
Equal to R138·75

Example 2.

45 days' labor at R1·25
45 days
125 cents

5625 cents equal
Answer R56·25

DISTANCES, &c., OF PLANTS.

Feet apart.	Square feet each.	No. per Acre.	Feet apart.	Square feet each.	No. per Acre.	Feet apart.	Square feet each	No. per Acre.
1 × 1	1	43,560	4½ × 5	22½	1,936	7 × 8	56	778
2 × 1	2	21,780	5 × 5	25	1,742	8 × 8	64	681
2 × 2	4	10,890	5 × 5½	27½	1,584	9 × 9	81	538
2 × 3	6	7,260	5 × 6	30	1,452	10 × 10	100	435
3 × 3	9	4,840	5½ × 5½	30¼	1,440	12 × 12	144	302
3 × 4	12	3,630	5½ × 6	33	1,320	15 × 15	225	193
4 × 4	16	2,722	0 × 6	36	1,210	17 × 17	289	151
4 × 5	20	2,178	6 × 7	42	1,037	20 × 20	400	109
4½ × 4½	20¼	2,151	7 × 7	49	889	25 × 25	625	69

No. of Trees ꝑ Cooly.	Coolies per Acre.	Cost per Acre of 1,000 trees:—in Rupees and Cents.								
		@ 30 cents.	@ 31 cents.	@ 32 cents.	@ 33 cents.	@ 34 cents.	@ 35 cents.	@ 36 cents.	@ 37 cents.	@ 38 cents.
10	100	30·00	31·00	32·00	33·00	34·00	35·00	36·00	37·00	38·00
20	50	15·00	15·50	16·00	16·50	17·00	17·50	18·00	18·50	19·00
30	33 1/3	10·00	10·33	10·67	11·00	11·33	11·67	12·00	12·33	12·67
40	25	7·50	7·75	8·00	8·25	8·50	8·75	9·00	9·25	9·50
50	20	6·00	6·20	6·40	6·60	6·80	7·00	7·20	7·40	7·60
60	16 2/3	5·00	5·17	5·33	5·50	5·67	5·83	6·00	6·17	6·33
70	14 2/7	4·29	4·43	4·57	4·71	4·86	5·00	5·14	5·29	5·43
80	12 1/2	3·75	3·87	4·00	4·12	4·25	4·37	4·50	4·62	4·75
90	11 1/9	3·33	3·44	3·56	3·67	3·78	3·89	4·00	4·11	4·22
100	10	3·00	3·10	3·20	3·30	3·40	3·50	3·60	3·70	3·80
200	5	1·50	1·55	1·60	1·65	1·70	1·75	1·80	1·85	1·90
300	3 1/3	1·00	1·03	1·07	1·10	1·13	1·17	1·20	1·23	1·27
400	2 1/2	0·75	0·77	0·80	0·82	0·85	0·87	0·90	0·92	0·95
500	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76

No. of Trees ꝑ Cooly.	Coolies per Acre.	Cost per Acre of 1,200 trees:—in Rupees and Cents.								
		@ 30 cents.	@ 31 cents.	@ 32 cents.	@ 33 cents.	@ 34 cents.	@ 35 cents.	@ 36 cents.	@ 37 cents.	@ 38 cents.
10	120	36·00	37·20	38·40	39·60	40·80	42·00	43·20	44·40	45·60
20	60	18·00	18·60	19·20	19·80	20·40	21·00	21·60	22·20	22·80
30	40	12·00	12·40	12·80	13·20	13·60	14·00	14·40	14·80	15·20
40	30	9·00	9·30	9·60	9·90	10·20	10·50	10·80	11·10	11·40
50	24	7·20	7·44	7·68	7·92	8·16	8·40	8·64	8·88	9·12
60	20	6·00	6·20	6·40	6·60	6·80	7·00	7·20	7·40	7·60
70	17 1/7	5·14	5·31	5·49	5·66	5·83	6·00	6·17	6·34	6·51
80	15	4·50	4·65	4·80	4·95	5·10	5·25	5·40	5·55	5·70
90	13 1/3	4·00	4·13	4·27	4·40	4·53	4·67	4·80	4·93	5·07
100	12	3·60	3·72	3·84	3·96	4·08	4·20	4·32	4·44	4·56
200	6	1·80	1·86	1·92	1·98	2·04	2·10	2·16	2·22	2·28
300	4	1·20	1·24	1·28	1·32	1·36	1·40	1·44	1·48	1·52
400	3	0·90	0·93	0·96	0·99	1·02	1·05	1·08	1·11	1·14
500	2 2/5	0·72	0·74	0·77	0·79	0·82	0·84	0·86	0·89	0·91
600	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76

		Cost per Acre of 1,300 Trees:—in Rupees and Cents.								
10	130	39·00	40·30	41·60	42·90	44·20	45·50	46·80	48·10	49·40
20	65	19·50	20·15	20·80	21·45	22·10	22·75	23·40	24·05	24·70
30	43 1/3	13·00	13·43	13·87	14·30	14·73	15·17	15·60	16·03	16·47
40	32 1/2	9·75	10·07	10·40	10·72	11·05	11·37	11·70	12·02	12·35
50	26	7·80	8·06	8·32	8·58	8·84	9·10	9·36	9·62	9·88
60	21 2/3	6·50	6·72	6·93	7·15	7·37	7·58	7·80	8·02	8·23
70	18 4/7	5·57	5·76	5·94	6·13	6·31	6·50	6·69	6·87	7·06
80	16 1/4	4·87	5·04	5·20	5·36	5·52	5·69	5·85	6·01	6·17
90	14 4/9	4·33	4·48	4·62	4·77	4·91	5·06	5·20	5·34	5·49
100	13	3·90	4·03	4·16	4·29	4·42	4·55	4·68	4·81	4·94
200	6 1/2	1·95	2·01	2·08	2·14	2·21	2·27	2·34	2·40	2·47
300	4 1/3	1·30	1·34	1·39	1·43	1·47	1·52	1·56	1·[illegible]0	1·65
400	3 1/4	0·97	1·01	1·04	1·07	1·10	1·14	1·17	1·[illegible]0	1·23
500	2 3/5	0·78	0·81	0·83	0·86	0·88	0·91	0·94	0·[illegible]6	0·99
600	2 1/6	0·65	0·67	0·69	0·72	0·74	0·76	0·78	0·[illegible]0	0·82
650	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·[illegible]4	0·76

		Cost per Acre of 1,400 Trees:—in Rupees and Cents.								
10	140	42·00	43·40	44·80	46·20	47·60	49·00	50·40	51·80	53·20
20	70	21·00	21·70	22·40	23·10	23·80	24·50	25·20	25·90	26·60
30	46 2/3	14·00	14·47	14·93	15·40	15·87	16·33	16·80	17·27	17·73
40	35	10·50	10·85	11·20	11·55	11·90	12·25	12·60	12·95	13·30
50	28	8·40	8·68	8·96	9·24	9·52	9·80	10·08	10·36	10·64
60	23 1/3	7·00	7·23	7·47	7·70	7·93	8·17	8·40	8·63	8·87
70	20	6·00	6·20	6·40	6·60	6·80	7·00	7·20	7·40	7·60
80	17 1/2	5·25	5·42	5·60	5·77	5·95	6·12	6·30	6·47	6·65
90	15 5/9	4·67	4·82	4·98	5·13	5·29	5·44	5·60	5·76	5·91
100	14	4·20	4·34	4·48	4·62	4·76	4·90	5·04	5·18	5·32
200	7	2·10	2·17	2·24	2·31	2·38	2·45	2·52	2·59	2·66
300	4 2/3	1·40	1·45	1·49	1·54	1·59	1·63	1·68	1·73	1·77
400	3 1/2	1·05	1·08	1·12	1·15	1·19	1·22	1·26	1·29	1·33
500	2 4/5	0·84	0·87	0·90	0·92	0·95	0·98	1·01	1·04	1·06
600	2 1/3	0·70	0·72	0·75	0·77	0·79	0·82	0·84	0·86	0·89
700	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76

		Cost per Acre of 1,500 Trees:—in Rupees and Cents.								
10	150	45·00	46·50	48·00	49·50	51·00	52·50	54·00	55·50	57·00
20	75	22·50	23·25	24·00	24·75	25·50	26·25	27·00	27·75	28·50
30	50	15·00	15·50	16·00	16·50	17·00	17·50	18·00	18·50	19·00
40	37 1/2	11·25	11·62	12·00	12·37	12·75	13·12	13·50	13·87	14·25
50	30	9·00	9·30	9·60	9·90	10·20	10·50	10·80	11·10	11·40
60	25	7·50	7·75	8·00	8·25	8·50	8·75	9·00	9·25	9·50
70	21 3/7	6·43	6·64	6·86	7·07	7·29	7·50	7·71	7·93	8·14
80	18 3/4	5·62	5·81	6·00	6·19	6·37	6·56	6·75	6·94	7·12
90	16 2/3	5·00	5·17	5·33	5·50	5·67	5·83	6·00	6·17	6·33
100	15	4·50	4·65	4·80	4·95	5·10	5·25	5·40	5·55	5·70
200	7 1/2	2·25	2·32	2·40	2·47	2·55	2·62	2·70	2·77	2·85
300	5	1·50	1·55	1·60	1·65	1·70	1·75	1·80	1·85	1·90
400	3 3/4	1·12	1·16	1·20	1·24	1·27	1·31	1·35	1·39	1·42
500	3	0·90	0·93	0·96	0·99	1·02	1·05	1·08	1·11	1·14
600	2 1/2	0·75	0·77	0·80	0·82	0·85	0·87	0·90	0·92	0·95
700	2 1/7	0·64	0·66	0·69	0·71	0·73	0·75	0·77	0·79	0·81
750	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76
	—	—	—	—	—	—	—	—	—	—

		Cost per Acre of 1,700 Trees:—in Rupees and Cents.								
10	170	51·00	53·70	54·40	56·10	57·80	59·50	61·20	62·90	64·60
20	85	25·50	26·35	27·20	28·05	28·90	29·75	30·60	31·45	32·30
30	56 2/3	17·00	17·57	18·13	18·70	19·27	19·83	20·40	20·97	21·53
40	42 1/2	12·75	13·17	13·60	14·02	14·45	14·87	15·30	15·72	16·15
50	34	10·20	10·54	10·88	11·22	11·56	11·90	12·24	12·58	12·92
60	28 1/3	8·50	8·78	9·07	9·35	9·63	9·92	10·20	10·48	10·77
70	24 2/7	7·29	7·53	7·77	8·01	8·26	8·50	8·74	8·99	9·23
80	27 1/4	6·37	6·59	6·80	7·01	7·22	7·44	7·65	7·86	8·07
90	18 8/9	5·67	5·86	6·04	6·23	6·42	6·61	6·80	6·99	7·18
100	17	5·10	5·27	5·44	5·61	5·78	5·95	6·12	6·29	6·46
200	8 1/2	1·55	2·63	2·72	2·80	2·89	2·97	3·06	3·14	3·23
300	5 2/3	1·70	1·76	1·81	1·87	1·93	1·98	2·04	2·10	2·15
400	4 1/4	1·27	1·32	1·36	1·40	1·44	1·49	1·53	1·57	1·61
500	3 2/5	1·02	1·05	1·09	1·12	1·16	1·19	1·22	1·26	1·29
600	2 5/6	0·85	0·88	0·91	0·93	0·96	0·99	1·02	1·05	1·08
700	2 3/7	0·73	0·75	0·78	0·80	0·83	0·85	0·87	0·90	0·92
800	2 1/8	0·64	0·66	0·68	0·70	0·72	0·74	0·76	0.79	0·81
850	2	0·60	0·62	0·64	0·66	0·68	0·70	0·72	0·74	0·76

MANURE TABLES.

TREES 6×7 FEET. Amount per Tree.	Amount per Acre of 1,000 Trees.		
Oz.	Cwts.	qrs.	lb.
1	0	2	6 1/2
2	1	0	13
3	1	2	19 1/2
4	2	0	26
5	2	3	4 1/2
6	3	1	11
7	3	3	17 1/2
8	4	1	24
9	5	0	2 1/2
10	5	2	9
11	6	0	15 1/2
12	6	2	22
13	7	1	0 1/2
14	7	3	7
15	8	1	13 1/2
16	8	3	20

TREES 6×6 FEET. Amount per Tree.	Amount per Acre of 1,200 Trees.		
Oz.	Cwts.	qrs.	lb.
1	0	2	19
2	1	1	10
3	2	0	1
4	2	2	20
5	3	1	11
6	4	0	2
7	4	2	21
8	5	1	12
9	6	0	3
10	6	2	22
11	7	1	13
12	8	0	4
13	8	2	23
14	9	1	14
15	10	0	5
16	10	2	24

TREES 5½×6 FEET. Amount per Tree.	Amount per Acre of 1300 Trees.		
Oz.	Cwts.	qrs.	lb.
1	[illegible]	2	25 1/4
2	[illegible]	1	22 1/2
3	[illegible]	0	19 3/4
4	[illegible]	3	17
5	[illegible]	2	14 1/4
6	[illegible]	1	11 1/2
7	[illegible]	0	8 3/4
8	5	3	6
9	6	2	3 1/4
10	7	1	0 1/2
11	7	3	25 3/4
12	8	2	23
13	9	1	20 1/4
14	10	0	17 1/2
15	10	3	14 3/4
16	11	2	12

TREES 5×6 FEET. Amount per Tree.	Amount per Acre of 1,400 Trees.		
Oz.	Cwts.	qrs.	lb.
1	0	3	3 1/2
2	1	2	7
3	2	1	10 1/2
4	3	0	14
5	3	3	17 1/2
6	4	2	21
7	5	1	24 1/2
8	6	1	0
9	7	0	3 1/2
10	7	3	7
11	8	2	10 1/2
12	9	1	14
13	10	0	17 1/2
14	10	3	21
15	11	2	24 1/2
16	12	2	0

TREES 5×5⅘ FEET. Amount per Tree.	Amount per Acre of 1,500 Trees.		
Oz.	Cwts.	qrs.	lb.
1	0	3	9 3/4
2	1	2	19 1/2
3	2	2	1 1/4
4	3	1	11
5	4	0	20 3/4
6	5	0	2 1/2
7	5	3	12 1/4
8	6	2	22
9	7	2	3 3/4
10	8	1	13 1/2
11	9	0	23 1/4
12	10	0	5
13	11	3	14 3/4
14	11	2	24 1/2
15	12	2	6 1/4
16	13	1	16

TREES 5×5 FEET. Amount per Tree.	Amount per Acre of 1,700 Trees.		
Oz.	Cwts.	qrs.	lb.
1	0	3	22 1/4
2	1	3	16 1/2
3	2	3	10 3/4
4	3	3	5
5	4	2	27 1/4
6	5	2	21 1/2
7	6	2	15 3/4
8	7	2	10
9	8	2	4 1/4
10	9	1	26 1/2
11	10	1	20 3/4
12	11	1	15
13	12	1	9 1/4
14	13	1	3 1/2
15	14	0	25 3/4
16	15	0	20

ɔF 1,200 TREES :—IN RUPEES AND CENTS.

@ cents.	@ 34 cents.	@ 35 cents.	@ 36 cents.	@ 37 cents.	@ 38 cents.
39·60	40·80	42·00	43·20	44·40	45·60
19·80	20·40	21·00	21·60	22·20	22·80
13·20	13·60	14·00	14·40	14·80	15·20
9·90	10·20	10·50	10·80	11·10	11·40
7·92	8·16	8·40	8·64	8·88	9·12
6·60	6·80	7·00	7·20	7·40	7·60
5·66	5·83	6·00	6·17	6·34	6·51
4·95	5·10	5·25	5·40	5·55	5·70
4·40	4·53	4·67	4·80	4·93	5·07
3·96	4·08	4·20	4·32	4·44	4·56
1·98	2·04	2·10	2·16	2·22	2·28
1·32	1·36	1·40	1·44	1·48	1·52
0·99	1·02	1·05	1·08	1·11	1·14
0·79	0·82	0·84	0·86	0·89	0·91
0·66	0·68	0·70	0·72	0·74	0·76

ɔF 1,400 TREES :—IN RUPEES AND CENTS.

46·20	47·60	49·00	50·40	51·80	53·20
23·10	23·80	24·50	25·20	25·90	26·60
15·40	15·87	16·33	16·80	17·27	17 73
11·55	11·90	12·25	12·60	12·95	13·30
9·24	9·52	9·80	10·08	10·36	10·64
7·70	7·93	8·17	8·40	8·63	8·87
6·60	6·80	7·00	7·20	7·40	7·60
5·77	5·95	6·12	6·30	6·47	6·65
5·13	5·29	5·44	5·60	5·76	5·91
4·62	4·76	4·90	5·04	5·18	5·32
2·31	2·38	2·45	2·52	2·59	2·66
1·54	1·59	1·63	1·68	1·73	1·77
1·15	1·19	1·22	1·26	1·29	1·33
0·92	0·95	0·98	1·01	1·04	1·06
0·77	0·79	0·82	0·84	0·86	0·89
0·66	0·68	0·70	0·72	0·74	0·76

ɔF 1,700 TREES :—IN RUPEES AND CENTS.

56·10	57·80	59·50	61·20	62·90	64·60
28·05	28·90	29·75	30·60	31·45	32·30

COST OF COFFEE.

(From the *Ceylon Observer*, February, 1871.)

Cost of Coffee: Raw and Roasted.—Amongst a bundle of papers laid by for consideration, we find a curious table published in the *Produce Market Review*, giving an "Estimate of the cost of 1 lb. of coffee when roasted, calculated from a bonded price of 15s. per cwt. The duty is taken at 3d. per lb., the cost of roasting at 3s. per cwt., and the yield of roasted coffee from 1 cwt. of raw at 92 lb." It thus appears that the loss of weight in roasting coffee is no less than 20 lb., while on tea there is no such loss. This fact is, of course, taken into account by purchasers, and ought to be calculated in comparing the value of tea and coffee for duty purposes. But, besides the loss in weight to the extent of nearly one-fifth, there is the cost of roasting to be deducted. We may safely therefore estimate the deduction in value at one-fifth, while tea is available just as it stands. Good quality coffee, therefore, in a condition ready for infusion, costs about the same as fair quality tea, and the infusion is not so easily made. These are, doubtless, amongst the reasons why the consumption of coffee does not increase in Britain. The effect of low prices remains to be seen, if they are to go down as we fear. Cheap coffee would be at any rate a heavy blow and sore discouragement to chicory. In the table before us, all the prices below 40s. are scored out, for, when the paper reached our office at the end of last year, the possibility of anything lower than £2 per cwt. in bond in London was not contemplated. Let us hope that they may not occur, but to look at all eventualities let us commence at 30s. 6d. At this rate per cwt. in bond the cost of 1 lb. roasted coffee would be 8d.; it would be 8½d. at 34s.; 9¼d. at 40s.; 10d. at 45s. 6d.; 10½d. at 49s. 6d.; 11¼d. at 55s.; 1s. at 61s.; 1s. ½d. at 65s.; 1s. 1½d. at 72s. 6d. (the price of good ordinary Ceylon on 29th August); and 1s. 2½d. at 80s.; 1s. 3d. at 84s.; 1s. 4d. at 91s. 6d.; 1s. 5d. at 99s. 6d. It appears that the cost of a lb. of roasted coffee, best Ceylon or Mocha, is as high as that of very fair black tea. As prices go down, of course the disparity becomes greatly in favour of coffee. But the fall in price has not been confined to coffee: tea also has been affected by excessive importations. So that the race remains much as it was, as far as England is concerned. Our hope is in the advancing consumption in America and on the continent of Europe.

MANURES AND THEIR APPLICATION TO THE COFFEE PLANT.

(*To the Editor of the Ceylon Observer.*)

DEAR SIR,—Like many a better man, I take a great interest in the planting correspondence of the *Observer*. Most coffee planting topics find exponents there. If the ideas expressed are not always convincing, they are often instructive, and always suggestive. "P. M." and "An Old Shuck Coffee-tree" should favour us with more of their views regarding cultivation; they would be appreciated I think by all your readers. In these matured utterances of experienced men, we find a sort of ready-made wisdom, which to us individuals would be slow of acquirement. And the more practical and valuable the suggestions are, the more readily we follow them and adopt them as our own.

Most fruitful and many-sided of subjects is that of Manuring. Have we not been hammering away persistently for years at the idea that all that was wanted to increase the crops and the profits was, manure. And has not manure been spread liberally all over Ceylon till even the coffee tree seems to enter a mild protest against the reckless extravagance. Poonac! Bones of all kinds, crushed, ground, steamed and dissolved! what have you done? Sulphate of Ammonia, and Nitrates of Potash, and Phosphates of all hues and smells! where are your results? Already a low but ominous sound is heard, "Miserable comforters are ye all," and the export sheet will soon confirm it. Excellent materials no doubt, all those I have named. Use them in suitable places and in an intelligent manner, and they must do good. Whether the amount of good they accomplish is proportionate to the expense incurred is another matter and one worth inquiring into. Such, however, is not my purpose now. In a future letter I may advocate a system, and prove some results, which would show that manuring, compared with high cultivation without manure, was but a very indifferent financial success. Meanwhile, manures of all kinds are being largely used as food for coffee trees. I wish to speak of the way in which these ought to be applied, In olden times it was, and is even now pretty generally, considered the correct thing to bury cattle dung and pulp in a hole near each tree, each hole being 18 inches or 2 feet deep and wide. Some planters preferred them larger, but at any rate the thing insisted on was *depth*. Woe betide the unfortunate sinna durai of a dozen years ago, who failed to exact the statute measurement from the coolies. Well, the hole was dug and the manure buried out of sight, and a mound of the excavated

earth raised over it. Ere twelve months had passed away, the planter looked fondly at his trees, and called his friend's attention to the way in which the cattle manure was "telling." Marked improvement was no doubt visible, as it was expected to be; for cattle manure is one of those good things that will not fail to improve coffee, however injudiciously it may be applied. But, while the coffee was feeling the benefit in one direction, let us see how matters stood in a general way. The planter had dug a hole as deep as the tap-root; and the greater part of the manure put there had subsided to a distance which rendered it impos ible for the surface roots to get any food from it. The loose soil taken from the hole, and used for covering the manure and heaping round the stem of the tree, begins to disperse with the first heavy rains. Ere long, and the "ere long" means not many months, it finds its way to the nearest road or ravine. The steeper the land manured happens to be, so will this result be hastened, but, let the slope be stiff or easy, one thing is certain, the soil you took from the manure hole will be washed to the bottom of the hill. In the majority of cases this soil was at least as valuable as the manure you replaced it with, if you only knew how to manipulate it. However, you chose to give the streams and paddy-fields the benefit of it, and pinned your faith to the paying results of its more expensive substitute. What profits you obtained are best known to yourselves, but I may tell you that the next time you found it necessary to have recourse to manure, these fields had become impoverished to an extent you were not aware of. And as the operation is repeated the ruin goes on, till after a few years the tree gets nearly all its sustenance from the manure, and hardly anything from the soil in which it was planted. Hence the notably shuck condition of coffee, once well manured, but now left to take care of itself. How can it be otherwise, when you sent all its valuable soil to the sea, and left its roots maimed and bare, to look down from above on the surface they may not enter again. The result, therefore, of your burying system is this, you lose the benefit of a great part of the manure by stowing it away beyond reach of the roots, and you lose not a little of your soil at the same time.

Some planters had long ago recommended what they called "wash holes," in the hope of preventing the waste I have been describing. Wash holes I grieve to see find advocates even now. A more mischievous system of cultivation, or one less adapted to stop wash, I could not point out. Any reader of this will be familiar with its results, if not on his own estate, at

least on those of neighbours. Promising enough these holes look when freshly cut, and very hopeful seems the future of the tree when encircled with the good-looking soil dug out of them. But very soon comes the end. The soil gets quickly washed back into the holes again, then out of the holes and down the hill, rutting and tearing away with it other soil which in ordinary circumstances would have remained intact for many years. And in a year or two you will see the trees perched up on their individual cones of earth, with their roots looking through the sides, and into the yawning holes that have done the mischief. You dug the holes to retain the surface wash: by and bye you find they have not only failed in this, but occasioned even a greater wash. Is it not so?

As the digging of large holes to bury cattle manures and other manures in is open to these grave objections, it is time that we left off such an expensive, and, in its consequences, ruinous item of labour. We must take to surface manuring. A host of critics, sensible men and excellent planters too, will be ready to attack this system at once: still if they give it a fair trial it will not be disappointed. It is not a new system though it is a good one. Nature has been employing it for thousands of years. The dying leaves and branches of her forests are being continually shed over the surface of the ground, permanently enriching the soil and increasing the vigour of the vegetation. Why should not we, as cultivators of trees, follow, as far as we may, her excellent plan? We have all noticed the wonderful effects, after cutting a road through coffee, of the loose soil thrown on the surface among the trees below. Look at the coffee near coolie lines or around cattle sheds, how luxuriant the trees are! Yet no holes were dug there, nor laborious application attempted. The ashes and other fertilizing substances scattered on the surface were soon commingled with the soil they rested on, and the appearance of the trees in foliage and in fruit tell how well these did their work. The practise of surface manuring is simple, while it is inexpensive. As a preliminary work it is necessary that the land should be drained. I am speaking here of steep land. On more level ground draining may be omitted altogether, or but sparingly used. Drains of easy gradients, say from 1 in 17 to 1 in 30, and from six to ten trees distant from each other, should be cut across the hillside and made to empty themselves into the nearest natural ravines. In average soils it would cost less to drain an acre, than to cut the number of big manure holes required in that space. And once made, the drains remain. Any further expense they may

occasion, will be in occasionally clearing them out, and that is but very trifling where they are placed so close together. Thus effectually protected from wash you may apply your manure. If cattle dung, or pulp, or bulky compost, pare down the surface of the soil all round the tree to the distance of a foot or more from the stem. To each tree apply a basketful or less of the manure, spreading it equally over this pared surface. Over the manure thus deposited, put a thin layer of earth taken over the raised surfaces generally found in the middle of the rows, and the job is done. If the coffee to be operated on has its roots already exposed, as will be the case where it has suffered formerly from big manure holes or wash holes, the roots require simply to be covered with the manure, and this last with the thin layer of earth to keep it compactly together and prevent evaporation. After this treatment, keep your fields free from weeds and watch the result. In much less time than under the holing system you will find the coffee improve, and the improvement will be progressive, for you have preserved your manure and your soil too. The manure has been placed in a position where it is equally accessible to all the roots, and as it gradually percolates downwards, the surrounding soil gets fertilized, rendering it able to sustain the increased requirements of the tree.

All the practical evidences I have seen in favour of this method have been most satisfactory, and I indeed hardly imagine a case where manure would be of value at all, in which it would fail. Planters will sometimes condemn it on such grounds as 1st—Waste by evaporation. 2nd—Waste by wash and weeds. 3rd—It brings the roots above the surface. These objections are only parts of a crude theory. The first two are got rid of by the treatment I recommend. The last is not so formidable as it looks. If the roots do appear to rise, recollect they are *new roots* and come no farther than the base of the manure, while they are covered again by the next application and able to derive sustenance from whatever is thrown in their way. All the active feeding roots of the coffee tree lie near the surface, then why not administer their food in the way in which nature evidently designed them to be fed.

In the past history of coffee-planting, can we not recollect many instances where valuable manures were applied with little or no result? Even now we are often puzzled with the seemingly capricious action of the same manure in different places, doing good here, and no good whatever there, while there seems no adequate cause to explain the different results. De-

pend upon it, the way in which manure is usually applied has a great deal to do with the failure. Any sceptical planter may find this out for himself by manuring two equally good or bad patches of coffee: one patch by the old plan of big holes, the other patch by the process I recommend. If he does not discover a marked superiority in the improvement of the latter, his experience will differ from my own.

Yours sincerely,

ORUM.

THE WET CYCLE AND SHORT CROPS.

(*To the Editor of the Ceylon Observer.*)

DEAR SIR,—The unusual quantity of rain which has fallen during the last few months would lead one to suppose that our worthy friend Mr. Tytler is right after all, and that we are fairly launched into the wet cycle, which, if his theory be correct, will continue for years.

Whether this be so or not, it is but too evident that its effects this year have been most disastrous upon high estates generally, and that unless the fine weather we have experienced during the past few days continues and brings out another blossom (it is forward in some districts) the crop of 1871-72 will turn out the shortest of any we have had for many years past. It behoves us therefore to consider how we may best counteract and mitigate the effects of future wet seasons, so far as it lies in our power. Climate we cannot alter, but we may to some extent modify its influence upon our crop.

1st and foremost in my opinion *deep draining* should be tried. I do not mean such drains as we generally see cut, to carry off the surface water only, drains 18 × 18 inches, but at least 3 feet deep × 18 inches or 2 feet wide, the nearer the better, but, for our purpose, probably every 12 or 15 yards would suffice. I need scarcely tell experienced planters, *that the earth* from their drains carefully spread over the surface and roots of the trees below the drains would be as good as a manuring, and should considerably reduce the cost of weeding and manuring, enough to cover the expense of draining the 1st year. 2nd, by *water holes*, as they are usually called, cut transversely across the slopes of the hills, size say 3 by 1½, or 2 feet broad by 18 inches deep, should be cut between every other square of coffee tree, and the earth distributed over the roots. I say "every other," because it reduces the cost one-half, and the operation could be made to extend over two years or more.

3rdly, *early pruning*: even at some sacrifice of crop, I would strongly recommend that this operation should be commenced if possible in the beginning of January. (I am writing for estates situated at an elevation of from 3,000 to 4,000 feet and upwards.) Lower estates commence pruning earlier as a rule. February, March, and April, are the months we have to rely upon most for blossom; early pruning would force this out before the wet season set in, and should not extend beyond March; if it could be finished by the end of February, the results would be all the more satisfactory. 4th, *constant handling*. Besides going over the whole estate rapidly, at least three times a year, I would employ a small force regularly during the intervals between the different handlings to remove and check the too rapid growth of young wood which we all know is excessive in wet districts. The trees should have all young wood taken off in a radius of say 12 to 15 inches from the stem; the more the midday sun can get to the stem and roots round the stem the better. The more mature the bearing wood at high elevations, the greater the chance of the blossom setting.

5th, *the early application of manure in all cases if practicable*. I would apply bulky manures such as cattle manures, pulp, rotten grass, and weeds, during the months of January, February, and March, and all artificial manures during the months of April, May, and June, commencing with the first rains. Farm-yard manure containing so much mixture, 70 per cent of water when well rotted, can be applied during the driest weather without disadvantage: the manures for high estates should be stimulating ones, especially when situated in cold as well as wet climates. They require different treatment to those situated in hot and dry localities. Long experience and careful observation are the surest guides, but this subject would require a treatise of itself. 6th, *hand weeding* is essential. "Shuck Coffee Tree," in a letter recently published in the *Observer*, truthfully describes the injurious effects of scraping, whether with mamoties or scrapers. Where draining, and the cutting of water-holes such as I have mentioned, are carried out, the surface in each acre to be actually weeded is reduced fully one-fourth. Contractors where they are employed (and a fatal day for coffee estates was it when that system was introduced, although it has doubtless enriched a few superintendents but not the proprietors) would have then much less ground to go over, the holes themselves would form ready and convenient receptacles for the weeds, and I apprehend there would be little or no difficulty in entirely su-

perseding the present ruinous, destructive, and most unsatisfactory system of mamoty and scraper weeding. Many estates have been utterly ruined by it, and hundreds more are rapidly going to ruin from the same cause. On the one side you feed the tree by applying manures; on the other, you destroy the feeding roots, which are finding their way towards the manure. May not this explain why manure does not tell on some estates? But there is another reason, and the "Shuck Coffee Tree" has again hit the right nail on the head. Many experienced as well as young planters apply their manures too deep: I have seen numerous instances of this amongst men who are looked upon as good planters. Cut your holes as deep as you like, 18 inches or more, the sub-soil brought to the surface will be improved by exposure to the atmosphere, but, before you apply your manure, fill in one-half, two-thirds would be better, apply your manure on that mixed with the earth you cover with, and if you have only two or three inches of earth above the manure, you have enough, just sufficient to shade it from the sun and prevent the escape of the ammonia or other nutritious gases evolved during the decomposition of the manure. There is more money wasted in ignorant and careless manuring than proprietors or agents wot of; there is no work requiring more careful attention and supervision. Holes should never be cut nearer than 18 inches or 2 feet to the stem for bulky manures. The large roots are torn and injured; often the branches as well, by the use of the mamoty too near the tree. If a knife was always used in paring the ends of the roots injured in cutting manure holes, water holes, or drains, little or no injury would follow: in fact, paring the roots of fruit trees to produce fresh roots, and force out fresh wood, is the usual practice at home. It stimulates the trees, and if these roots to produce fresh roots find manure at hand, crop *must follow.* I am inclined to think that a sharp knife or an adze would perhaps answer the purpose better, passed in a semicircle 2 or 3 feet from the tree on the opposite side of the tree to that on which manure has been applied. Cutting all the surface roots to the depth of a few inches now and then would improve the quality of the sap by cutting off a portion of the supply of moisture it is drawing from the soil, and forcing the undivided roots on the manured side to assimilate a larger proportion of the more nutritive constituents contained in the manure. It is well known that sap in excessive quantities is impoverished and diluted; reduce the quantity and improve the quality at the same time, and you will find your blossoms not only

heavier, but set better. Where the soil is exhausted and poor, the roots draw little else but moisture from the soil, just to keep themselves alive: blossoms show again, and again, but do not set; why? because the sap is weak and poor in quality, its fructifying power is wanting or weakened.

Trusting that my remarks may be of some use to my brother planters, I remain, dear sir, yours faithfully,

R. J. CORBET.

MR. CORBET ON THE CULTIVATION OF COFFEE IN HIGH DISTRICTS.

(To the Editor of the *Ceylon Observer.*)

Colombo, 2nd June 1871.

SIR,—Since writing my letter I have read one under the signature of "Orum." Whilst agreeing with him in many particulars, I differ from him on the subject of water holes, unless combined with an efficient system of careful draining, and if the draining should be done *first,* the results he notes would follow. *Both* holes and drains must receive equal attention, and be kept open, otherwise they are apt to do more harm than good. Surface manuring as he describes it I have tried, and with good effect; the great objection to it is, that weeds spring up in the manure, that weeding contractors will not give themselves the trouble to pull out these weeds with the hands, but scrape away weeds, manure, and the slight covering of earth together, and the roots which were spreading into the manure are exposed, die, and the state of that tree after a few months becomes worse than before. Do away with weeding contractors if you can, weed with the hand, and then by all means apply manure on the surface, on level, or at all events tolerably level ground and easy slopes. It will not be found to answer so well on steep sides of hills. In my remarks upon pruning and handling, I should have dwelt upon the importance of low topping on high estates. 3 feet should be the maximum height; 2½ or even 2 feet will be found to answer best in poor soils, on all ridges, and where exposed to wind; don't wait until your trees are blown over, top as soon after they have reached the required height as possible, but top in the brown, and not in the green wood.

Hedge-rows of coffee planted close, 2 feet apart or even closer every here and there on exposed features, across the direction of the prevailing wind, will be found useful; the coffee must be allowed to grow nat-

ive fashion, staked when young if necessary. It forms an excellent hedge, and you have the advantage of losing no ground, as would be the case if you planted any other description of tree for shelter. Manure the hedge well, and it will afford ample protection to several rows of coffee. Has "Orum" tried "liquid manure" for coffee. Of all the manures I have tried, and I commenced manuring 25 years ago, liquid manure surpasses everything. It must be applied well diluted, by allowing a stream of water to run into the tanks, and directing it in little channels or rills to catch coffee trees in turn, scraping away the earth near the stem to form a hollow to receive and retain the liquid. One or two coolies can go over a considerable quantity of ground in a day; it must however be repeated three or four times a year, but well repays the small outlay incurred. Cattle sheds must, of course, be constructed with tanks to receive the liquid manure in such situations as to render this operation a simple one, the great desideratum being water handy, and slopes of coffee below the sheds conveniently situated for irrigation. I have seen very shuck coffee indeed rapidly restored under this method.—Yours faithfully,

R. J. CORBET.

A CONVERSATION WITH A SHUCK COFFEE TREE: THE COFFEE TREE ITS OWN ADVOCATE.

(*From a Planter of over Thirty Years' Experience.*)

MASTER :—I should very much like to know what you have to say for yourself why you should not be abandoned. You have not given sufficient fruit for the last 6 or 7 years to pay for the looking after you and keeping you clean, and I am every year running more and more into debt, under the impression that you are going to give me something in return, but you give scarcely anything, and I shall be obliged to give up taking care of you soon.

TREE :—I am very sorry for you, and would be very glad to give you plenty of fruit, but you put it out of my power to do so. Every month you send mamoties, and scrapers, and you cut off the greater part of my feeding roots, and I have been every month for the last six or seven years trying to make new roots to feed myself with, but before they are of much use to me, your people come again and cut them off, which has had the effect of keeping me in a state of continual starvation.

MASTER :—Starvation, say you! how can that be? have I not sent people and put food for you in a hole so deep that neither mamoties nor scrapers can take it from you? but still you don't thrive, and I am beginning to think you are ungrateful and altogether unworthy of being taken care of.

TREE :—I am very sorry you have so bad an opinion of me, but I tell you again, that my not thriving is all your own fault. It is true you have put food in a hole for me, but in making the hole your people cut a large quantity of my roots, and I could not make use of the food until I had made new roots, and by that time the food had gone too low in the ground for me to get at it.

MASTER :—But have you none but surface roots?

TREE :—None that will put fruit on my branches. Lay food for me on the surface of the ground, so that I can get at it without forcing my roots against their nature to seek for food you put in a hole, and you will soon see not only good vigorous wood on me, but plenty of fruit too, and in place of your going into debt, you will soon be out of your agent's hands if you will only take my advice.

MASTER :—But most people who have the care of you are afraid to feed you in that way for fear the sun would dry the good out of your food one part of the year, and the rain would wash it away from you the other part.

TREE :—Well! if people won't understand my nature I can't help it, and I shall just go on as usual until you change your system of feeding me, but after this don't blame me. I have told you what I want you to do, and if you are afraid to do as I want you, you must take the consequences and continue to go into debt, deeper, and yet deeper still; but if I was in your place, I think I could find some means of preventing either sun or rain from injuring the food laid on the surface. I could make drains in the first place right across the hills and so close together that there should be no very large accumulation of water. Next I would dig holes betwe n every four trees in the centre, between the four so as not to cut off the feeding roots which are nearer the stems. Next I would lay the food for the tree round the stem and cover it with the earth taken out of the hole, and what with the drains and the hole in the centre, it would be hard to wash away food laid for me near my stem.

MASTER :—Do you think this system would answer on very steep land?

TREE :—Yes, all you have to do is to make your drains a little closer together on steep land and don't send mamoties or scrapers there for the future.

Master :—Mamoties and scrapers, it seems you have a great hatred to those two implements.

Tree :—Yes, I have the greatest hatred possible to them : they have been the death of a great number of my relations, and they will be the death of me if you don't put a stop to them.

Master :—Are you not aware that if the weeds were allowed to grow they would choke you altogether, and that would be worse than now. You have an existence, although you say it is a miserable one, but if I was to stop the scrapers you would soon be checked for the want of health.

Tree :—If you make the drains and holes I have told you and feed me well, I think you might at the same time stop the scrapers, as there would not be so much surface to grow weeds on. Say the hole you make is two feet square and ought to be two feet deep, then the earth out of the hole covers a large space under each tree : altogether I think you might take the opportunity of taking the weeds out by hand the same as formerly, and I would thrive better for it.

Master :—I am afraid the land about you would not look so clean and tidy as it does when it is scraped once a month, and some people are very particular about this, especially my visiting agent.

Tree :—I take it you would rather have me in good health and able to work for you than to see me in a sickly state the same as I have been for the last six or seven years, and not able as you say to pay for being taken care of, and if you do everything I have told you to do, there will be very few weeds grow, my branches will be so full of leaves that only the rankest weed will grow under them, and if they are pulled up and laid near my roots I shall feed on them when they decay.

Master :—Then you think if your advice is taken about the way your food is given to you and the mamoties and scrapers done away with as far as weeding is concerned, that those who look after you would get a larger profit from you then they have hitherto done.

Tree :—Of that I am quite positive, and you would not hear so much about people spending all their own money taking care of me and then going to borrow money from others, only to keep them going for a year or two until they can borrow no more money, and then I am given over to the lender to pay himself out of me, but if my system of giving me my food is not adopted, he will soon be as hard up as the person he took me over from.

Master :—I think your advice is good, but I can

remember, when you were younger than you are now, that you used to give more fruit without any food being given to you, than you do now, with ever so much food given to you.

TREE :—You will keep saying ever so much food, when I have told you already, that your present sysem of putting my food in a hole prevents me from getting more than a very small portion of it. The reason I used to bear more fruit when I was young, was because you cut down and burned all the large trees which formerly stood here, and that left a considerable quantity of the proper kind of food for me on the surface, and I got at it easily, for at that time there were no scrapers to cut my feeding roots monthly, the same as now.

MASTER :—You say the proper kind of food for you. I should very much like to know what is the proper kind of food for you ; there are various opinions on that subject.

TREE :- I can make use of many kinds of food, but what I like best is that which has a good deal of potash in it, witness my vigorous growth when I was young, from the potash left on the ground after the burning of the large trees.

MASTER :—How often do you require feeding. There are various opinions about this : some say every year, some say every two years, and there are those who say that every third year is enough.

TREE :—All these various opinions only prove what I told you at first, that my nature is not understood. If you will take my advice you will give me a plentiful dose the first time, when you make the drains and holes I have advised you to make, and every year after give me about half the quantity, laying it always near my stem, and cover it up with any deposit you may find in the square hole, which is always to be emptied once a year, and I will give fruit every year, but those who only feed me every second or third year will only get fruit from me every second or third year.

MASTER :—If your advice is taken it will cause a complete revolution in the way of taking care of you.

TREE :—Yes, there will be a great revolution if my advice is taken in every particular. The agents now are the masters of the estates, but let my advice be followed for four or five years, and the proprietors will be the masters of their own properties again. Look at your purse ! how slender it is ! Do as I have told you for five years, then come and shew it to me, and I am confident it will have a larger corporation than it has now.

MASTER :—There is another operation called pruning: what have you to say about that?

TREE :—There is no use talking about pruning until I see how you make use of the lesson I have just given you. If that is made use of there will be something to prune, and I may be inclined to hold another conversation with you on that head by and bye, and I hope I shall not then have to sign myself

A SHUCK COFFEE TREE.

A CONVERSATION WITH A COFFEE TREE WHICH WAS NOT SHUCK.

MASTER (TO A COFFEE TREE NEAR THE LINES) :—I am very glad to see you in such good health. You are not like one of your relations I had a conversation with a short time ago, and I should like to know how you keep in such a good state of health, while others of your relations not far from here are so very poorly. I have been feeding them every now and then, but they don't appear to derive much benefit from the food I give them, and I don't recollect ever having given you the smallest particle of food at any time, still you always appear to keep in good health.

TREE :—You are perfectly right. You have never given me food, but I get food in another way, and in a way that suits me better than the way you give food. If all food was given to my relations in the same way that I get mine, you would see them thrive better on what you do give them. I get my food all on the surface of the ground, and there is a great deal goes to waste; myself and my friends can't consume the whole of what is deposited here, and we do wish sometimes that our poor relations could get at what we don't want.

MASTER :—Is there no possibility of the food you have in excess being conveyed to your poor starving relations?

TREE :—Yes: if I should tell you how to do it, I am afraid you will take all from me, and give to those you think want it more than I do.

MASTER :—I can't know what others may do, but as long as I have anything to do with you I promise you shall get your fair share of food, and in the way you want it, if you will only tell me how I can get the food you have in excess.

TREE :—I think I may tell you without fear. Do you see those lines? Examine them, and you will find there is no W. C. to them. The consequence is that every person has to find a W. C. for himself, and

he finds the most convenient one is under our branches, and we thrive on what is left there, but even this might be improved. We get our food before it has been fermented, but if it was fermented one-twentieth part of the food we get would be quite sufficient for us.

MASTER:—I don't see how what you say is left under your branches could be collected, and it can't ferment except there are considerable quantities collected in one place.

TREE:—Can't you just listen to me a little and I will tell you how to do it. You make large cisterns in the ground in a convenient place, two cisterns to each line. Over the cisterns raise walls and a roof, have a boarded floor over the cisterns, quite tight to prevent unpleasant consequences as much as possible, and have comfortable seats the same as you have for yourself, and I have no doubt you will be able to get your people to use them. Empty them every 3 or 6 months; the contents of the cistern will then be fermented and a very little will go a long way.

MASTER:—But the expense of these buildings will be a good deal, and as far as I can see they will be of no use except the cisterns are made water-tight.

TREE:—You are perfectly right about the cisterns, they should be made water-tight, and the best way to make them permanently water-tight is to line them with a good thick coat of asphalte, and be very particular that there are no cracks left in them and no pure water should be allowed to enter them, or it will stop the fermentation, and that is what we require. There are some people now who are making an attempt to collect these leavings, but the seats in their buildings are not half comfortable enough, and they have a lot of dry earth which will not allow of fermentation; but you take my advice: have your building as comfortable as possible, and I can assure you, you will not have to spend so much money in buying manure from the merchants, which some people say is not worth the bags it is imported in.

MASTER:—Suppose I go to the expense of these cisterns and buildings, how much of the fermented material would be sufficient food for one of you for 12 months?

TREE:—If you do everything the same as I have told you, 4 oz. mixed with ashes or any rubbish would be quite enough for 12 months, if it is supplied on the surface of the ground, and suppose one person only deposited 4 oz. in 24 hours, and 4 oz. being quite enough of the fermented material for one tree for 12 months, four depositors would be quite sufficient to manure one acre in a year, 400 would be quite sufficient to keep a hundred acres in as good

health as you see me in now, but it must all be applied on the surface.

MASTER :—Would not the heavy rains wash it away, and would it not be better to make a hole near your roots to put the mixture in to prevent it being washed away from you?

TREE :—Make no holes. If you do, you cut our feeding roots, which are all on the surface. Look at those thread-like things you see covering the whole of the surface near your feet; there are millions of them, and every one of them is a mouth, and you destroy one of our mouths, in every one you cut off in any way. Besides that, if the mixture is laid on the surface, our leaves get a share as well as our roots.

MASTER :—Ah yes: I suppose your roots turn the substance of the mixture into sap, and so it is carried to your leaves.

TREE :—Not so, but every night after dark there is an exhalation takes place, and our leaves have mouths to take that in, and they delight in the effluvia from such mixtures as I have instructed you to make.

MASTER :—This is something new, and I candidly confess that I don't quite understand all you have told me yet, but I will try to do so.

TREE :—You have learned men amongst you, one in particular, who has taken a great deal of pains to understand the nature of all insects which give us trouble. Could you not get one like him to turn his attention to the study of the coffee tree. There are a few who have written a great deal about us, but they do not act yet like people who understand their business. I will tell you how to begin the study. Take out your knife and stir the earth about here, and you will find, as I told you before, millions of small thread-like roots, and tell me, you who are so fond of making holes for my food, why all those mouths are right on the surface, and not lower in the ground?

MASTER :—Really and truly I don't pretend to understand why your roots are all on the surface, and to tell you the truth, I know nothing of your nature, except what you have told yourself; but there is a learned man at this present advocating the cutting of your roots with a sharp knife all round to make you give more fruit, and he says that fruit trees are served in this way in Europe, to make them give more fruit.

TREE :—I strongly suspect that whoever advocates such a ruinous system has not sufficiently studied our nature; it is true that trees in Europe have their tap-roots cut to make them bear fruit, but that has

nothing to do with us. We are constructed after quite a different fashion to the trees in Europe, and, as I told you before, get one of your number, who is learned in vegetable nature, to turn his attention to the study of our particular nature, and I am quite confident he will tell you before long neither to cut holes for our food, nor cut our roots in any way if you can help it.

MASTER :—Before I go will you tell me, suppose there is not ashes enough lying about at the time I empty the cisterns to mix with the contents, what would be the best thing to mix with it, for it is certain, if it is not mixed with something, the coolies won't carry it.

TREE :—The soil from a bank, if one is handy; if not, make a hole and take out the sub-soil and mix that with the contents of the cisterns, in such proportions that you will be sure that 4 oz. of the pure contents of the cisterns shall be in every portion applied to each tree.

MASTER :—Why do you say that sub-soil and not surface soil which might be got easier is the best.

TREE :—Because the surface soil has had a great deal of its strength taken out of it, and the sub-soil has in itself all that is required for the growth of any plant or tree, and only requires to be exposed to the action of the sun and air to make it as good as the surface soil was, when you first cut down the jungle, and by being mixed with the contents of the cisterns and laid on the surface it will get the requisite exposure, and after we have used up all it contains from the cisterns, it will be in a fit state to serve as food for us itself.

MASTER :—I am very much afraid of the expense of the buildings necessary to enable me to make use of the information you have given me, but I am thankful to you all the same.

TREE ;—You are very welcome to the information I have given you, and I hope when you have made your buildings and begin to reap the benefit from it, that you will not be ungrateful for the information, by carrying all the contents of your cisterns past me, and giving it all to those who have done very little for you, thereby obliging me at some future time to sign myself

A SHUCK COFFEE TREE.

MR. W. SABONADIÈRE ON SURFACE MANURING.

Delta, Pussellawa, June 9th, 1871.

DEAR SIR,—As you have invited discussion on the subject of manuring coffee estates, permit me through

the medium of your columns to make some remarks upon two communications which have lately appeared in your paper: viz., "Conversation between a Shuck Coffee Tree and its Master," and a letter signed "Orum." You are correct in stating that the publication of such letters does much good, there is a good deal in both these communications worthy the serious consideration of planters; and I can only express my hope that the valuable hints there given will be largely availed of. At the same time as planters like doctors disagree, I will proceed to explain on what points I do not entirely agree with "Orum," and, as a planter of 26 years' experience, I trust I shall not be considered presumptuous in stating my opinion.

Much as "Shuck Coffee Tree" and "Orum" deprecate the use of holes for the application of manure, it cannot be denied that the process where *properly carried out* has hitherto been a success. I can myself vouch for the effects of cattle manure lasting three years when so applied, and wherever I have so buried artificial manures, they have also yielded good results. I quite agree with the writers in question, *too deep* holes are not the correct proceeding, and that the cutting of the large roots is very injurious; but there is "a happy medium" in all things. I have always thought that holes for cattle manure or pulp should be cut one foot deep, and artificial manure holes six inches deep, and "care must be taken not to injure the large roots." I contend that such holes are not too deep for the generality of our estates, where the land is more or less steep, as the manure when thus applied does get to the feeding roots. Whilst I say so much in defence of the past, I quite agree with "Orum" and "Shuck Coffee Tree" in believing that to apply the manure on the surface of the bared roots would be even more effective and certainly quicker in yielding results. Still even with drains to every eight rows, I fear that most of our coffee lands are too steep for such a process. I would therefore adopt the surface manure plan on flat and slightly sloping fields, but would adhere to the old system of holes in steep land: being careful not to make them deeper than the level of the lowest fibrous roots, and taking special care by using quintanies in lieu of mamoties, to prevent the main roots being cut. All planters know the awful thunderstorms we usually get in April and October of each year, and what the weight of rain and the wash then are, sweeping everything as it were before them. I hardly think that on such occasions in steep fields, even in closely drained land, manure applied to the surface and only slightly covered over could be otherwise than washed away from

the stems into the drains. When "Orum" wrote "We must take to surface manuring," he should have added, "where the lay of the land is not too steep." I cannot see the force of his reasoning why the earth from the water holes "should be quickly washed back into the holes again" (if the land is drained) any more than the manure he tells us to "put round the stem of the trees," covered only with a slight layer of earth "to prevent evaporation." Another objection to surface manuring would undoubtedly be weeds: the "Shuck Coffee Tree" tells its master, "My branches will be so full of leaves, that only the rankest weeds will grow under them, and if they are pulled up and laid over my roots, I shall feed on them when they decay." Very true, as applied to very fine thick old coffee, but what about "Cootch," "Ammaley," and other bad grasses, which would become rampant in patches of old coffee? And it is generally admitted that nothing is more impoverishing to land than bad grasses. Still I agree it would be better to have your estate a little weedy if it gave good crops, than have it perfectly clean and not yielding good profits. Another difficulty would be preventing contract weeders from weeding out the manure from under the trees, especially where the land is not water-holed, which plan "Orum" objects to. The best plan assuredly is that of our "Shuck Coffee Tree," who insists on water-holing in old coffee, and it might be made part of the contract weeders' duty to empty out water-holes, as well as weed, and dig out bad grass. "Orum" is dead against the use of scraper and mamoty, yet he contradicts himself when he says, over the manure thus deposited (round the stem) "put a thin layer of earth taken off the raised surface generally found in the middle of the rows." Now in old coffee that has been properly weeded, and the loose soil and weeds drawn in round the stem, no raised surface ought to be found. Therefore to get sufficient earth to cover the manure, he must scrape away the surface soil and expose the very feeding roots which he tells us are damaged by hoes and scrapers. Query? would it not be better—especially in young and clean estates—to cut a small hole, laying the manure well amongst the roots, and cover it over very carefully with the fresh soil obtained from the hole; and leave the surface which may have always been hand-weeded, and have never suffered seriously from wash, undisturbed? *Drains.*—I agree altogether with "Orum" and "Shuck Coffee Tree" about the absolute necessity of drains, and do not think eight trees apart too near. Experience shews me that 1 in 12 to 1 in 15 is the best gradient at which they

should be traced; 1 in 17 to 1 in 30 is decidedly too level, as even at the gradient of 1 in 15 drains are very apt to choke. How we old coffee planters can have been so shortsighted as not to see long ago the urgent necessity of draining land is puzzling, but I suppose it is on the same principle that spouting and other improvements were not deemed necessary until later years. At all events, on this one point of draining planters are all agreed; the steeper the estate, the closer should the drains be cut, and no manure should be applied till the field has been thoroughly drained. I would recommend that all new clearings should be drained as soon as planted and before the trees begin to cover the ground. I go entirely with "Shuck Coffee Tree" as regards the water-hole system as applied to old estates. Draining alone should be sufficient on young estates, where the roots are of course well covered, and where mamoty weeding has never been practised. "Orum" points to the coffee round the lines, and the virgin forests as examples why we should adopt surface manuring. No doubt he is right; still we cannot build lines all over our estates; nor are our coffee fields protected from sun and wash as are the forest lands. Water-holing is not the "mischievous system of cultivation" "Orum" would make us believe if properly carried out; it might as well be said that pruning is mischievous, because, if not followed by handling and proper care, it would render "confusion more confused." Water-holes must of course be combined with thorough draining, they should frequently be cleared out, and the contents spread round the stems of the trees. Unfortunately, in these days of short labour and economy, there are seldom sufficient coolies on an estate to carry out that system of cultivation which is absolutely necessary for the maintenance in good and paying order of old coffee. Then again about water-holing "Orum" somewhat contradicts himself: he bids us notice the "effects of the loose soil thrown on the surface among the trees below," and yet he deprecates water-holes. Is not the principle the same? and what other process is likely to yield sufficient soil to cover over the roots of old trees which have suffered from heavy wash and a bad system of mamoty weeding? That is weeding *out* from the tree, instead of in towards the stem. But of course water-holes should be cleared out occasionally, and the contents spread over the roots. This seems to me the best means of restoring loose soil and humus to our exhausted fields, and allow room for the propagation of those fibrous roots so necessary for the well-being of a coffee tree. I have noticed that when water-

holing is performed for the first time in good soil it has the same effect as the application of cattle manure.

Before closing this long letter, I would express my opinion that to prevent main roots being cut, to ensure the holes being the proper depth, to keep weeding contractors from scraping the earth off the roots of the trees, more supervision is wanted on the generality of estates. This subject I would commend to the attention of Visiting Agents; I find that it pays to have plenty of supervision as the work costs less, and is undoubtedly better done.—I am, dear sir, yours faithfully,

WILLIAM SABONADIERE.

COFFEE CULTIVATION: MANURING AND PRUNING IN HIGH DISTRICTS.

June 19th, 1871.

DEAR SIR,—If we take up a young coffee tree out of its hole in the field, we find as many feeding rootlets all the way down to the bottom of the hole as near the surface, if the hole has been filled with surface soil. If we take up a plant in a nursery we find the same, so far down as the soil has been dug. If we take up an old coffee tree we find pretty much the same thing, so far as the hole it was planted in goes. If in cutting a road, or levelling, we cover up the surface soil round the coffee trees below with a foot or two of red sub-soil, we shall find, even many years afterwards, very few feeding roots near the surface of this sub-soil; but the old surface soil below, with perhaps the surface soil first thrown down from the cutting, will have plenty of them, though buried to a good depth by pure sub-soil. If we dig up, in last year's manuring, the cattle manure or pulp, buried in holes eighteen inches deep, we find it a mass of coffee rootlets at the full depth. When the manure is exhausted these rootlets of course disappear, being always formed where there is nourishhment, and they die off just as the leaves. If the deep coffee tap-roots be got down to, in a cutting, and any nourishing material be laid at the foot and within their reach, as an accumulation of earth in a drain at the foot of the bank, the tap-roots will produce feeding rootlets in this. All these things may be seen by most planters any day; why then are the feeding roots of coffee nearly all near the surface?

In young coffee the first grown larger roots are the downward growing or tap-roots, and there are at first no very large horizontal roots. The horizontal roots near the surface acquire size afterwards, as the tree

grows older and fills the surface soil with its feeding rootlets to a greater extent and distance. Then most of the growth of the tree is carried on through these large horizontal roots, but the tree seems rather to seek it farther down. The reason of all this is, I think, because only on the surface is there nourishment for the roots to find.* Many planters who have made vegetable gardens, or even coffee nurseries, must be well aware of the badness of our soil, generally at the depth of a few inches. They must have found that their deep digging, and mixing the soil, spoiled their garden, and that in spite of heavy manuring things would not grow for them at all to compare with what their coolies grow in their gardens without manure, and by simply scratching the ground on the surface. Our sub-soils are not by any means easily or soon improved, either, and the first inch of the surface is the best.

Of course, putting manure on the surface it may be expected to act sooner, and often will, as the feeding roots are there ready to make use of it. But much depends on the kind of manure, and much on the nature of the soil. I have found coffee pulp put on the surface, or even shallow holes and slightly covered, have very little effect, whereas in the same place when put in good holes and well covered no manure surpasses it. Earthy rubbish from the cooly lines I have found have the best effect when put on the surface, but it is usually so full of seeds as to make the weeding expensive on a clean estate. I would not think of putting manure very deep into a bad sub-soil in any case, nor of digging either manure or water holes into a retentive sub-soil in which they would retain stagnant pools of water.

I think water holes would be quite likely to cause wash unless they are effective always in holding all the water till it percolates away. A moderate quantity of water will run pretty clean off an old exposed surface which would run thick mud off freshly turned-up soil. Then water running out of water holes would run out in considerable rills, instead of being evenly spread. To cut a large hole at all, in steep ground, necessitates a high bank on the upper side which the trees will look perched on the top off. Drains should be steeper, the more steep the ground is, as more earth and stones are apt to get tumbled into them, and small slips of the upper bank are apt to choke them. A drain choked up in a heavy shower is most mischievous. The water collected is all turned out at one spot, and ruts up the ground down to the next

* Coffee roots seem also to like a loose open soil.

drain, which the quantity of stuff thus brought down will most likely choke also. But on places known to me, now nearly twenty years old, there are scarcely any signs of wash, and there are no wash holes on them and very few drains, except roadside drains. The reason of this is clean weeding (not scraping), and letting the prunings and fallen leaves lie on the surface of the ground. Under any considerable accumulation of these, the feeding rootlets grow out of the ground and through amongst the rotting leaves.

With regard to the idea of forcing out the blossom earlier by early pruning, I have never found it so. I long ago made experiments to try this, and I think I have pruned in about all the months of the year. This season I began a series of experiments in the middle of December, when crop here was little more than begun. Since then I have pruned experimental lots each month. In the first of these, the greater part of the crop had to be pruned off, and a good deal in February, and even in March. The first blossom on all of these too came on the same day as the first blossom on all the surrounding coffee, and there was not more of it on any of the pruned experiments. The second blossom also came on the same day, on both pruned and unpruned, and looked, when out, if anything, less on the earlier pruned lots. A third blossom has now been out, also about equal, and on the same days all over. There are, no doubt, advantages in early pruning, however, in most coffee: though I would not sacrifice scarcely any crop to be a little earlier. I do not mean to discuss the advantages here. They are mostly in the year after with me. But unripe berries late on a branch seem to retard the blossoming of its own extremity, if there be fresh blossoming wood there.

X.

WHAT IS A WEED?

A planting correspondent writes:—"I enclose an article clipped from the *Melbourne Leader* of the 25th March, on 'What is a weed,' which I think those of our coffee cultivators who are constantly in the habit of *bagging* their weeds (under pretence of eradicating them) will do well to study."

Weeds.

Sir,—Among your notices to correspondents in *The Leader* of the 11th, I was a good deal surprised to read that weeds did not impoverish soil. It staggered my ideas a bit, for ever since I was a boy, and used to spud up docks and thistles, I have believed as I

was taught then, that weeds are bad everywhere, whether in a crop or out of one, and that they rob the soil I think there cannot be a doubt. In proof of what I say, weeds always take possession of poor land, and where they do, it is useless to try to grow any crop, and the land gets poorer and poorer. Now if the weeds did not impoverish it, what makes it poor? Then, if I manure a piece of land and there happen to be seeds of weeds in the manure, and if these weeds grow up, am I to think that they do not rob the land of the manure I had put into it? I can hardly think that you will say so, and yet I cannot tell what to make of your notice to your correspondent if it does not mean that. If I am wrong, I trust you will tell me so in your notices to correspondents. I am, sir, yours respectfully,

W. F.

Sandhurst, 18th March.

What is a Weed.

We might lay before our readers a list of the names:—(1) Of weeds, the seeds of which are found in samples of grain, and by their presence detract from its value both for seed aud for milling purposes; (2) Of weeds which infest fallow land, and which it should be the object of the farmer to destroy when he subjects his land to the process of fallowing; (3) Weeds which encumber the soil, but whose seeds being small do not find their way into the sample of corn; (4) Those called underlings, which are similar in many respects to those in the third class; (5) Weeds which infest pasture lands. All this we might do as it has already been done in works on agriculture. Nay, we might give long lists under each of these five heads, classifying the various so-called weeds as annuals, biennals, and perennials, coupled with the common English and the uncommon botanical name of each; showing which are troublesome on account of their roots, or rather underground stems, and which are obnoxious on the score of their seeds. But if all this had been done, we should not have advanced one step towards answering the question which forms the heading of this article. This question we have been led to ask, and shall endeavour to answer, from the perusal of a letter on the subject which will be found in our correspondence column signed "W. F." The production of weeds is part of the curse imposed on the soil in consequence of man's first transgression; and curiously enough, it is the retribution that follows the wrong of exhaustion: "Thorns also and thistles shall it bring forth to thee, and in the sweat of thy face shalt thou eat bread." Thus the production and destruction of weeds

are both the result of wrong doing—outraging the decrees of an all wise Creator. Weeds have been held in great detestation by all true cultivators from the days of Job, the patient, upright farmer of Uz, who, on his farm, employed no fewer than 500 yoke of oxen. In his solemn protestation of the integrity with which he had fulfilled the several duties of life, and making the proper cultivation of his land the culminating point in his declaration, he says:—"If my land cry out against me, or the several furrows thereof likewise complain, let thistles grow instead of wheat, and noisome weeds instead of barley."

Having thus shown that a mere list of the names of so-called weeds would not help us to a solution of our question—that weeds are a consequence of the transgression on the part of man of Nature's laws, and that conscientious and careful cultivators from the days of Job down to those of W. F., have always held them in the utmost abhorrence, we now come to the question itself, "What is a weed?" When this question was put to an old farmer who was denouncing weeds in general, he indignantly replied, "A weed is a useless plant that robs the soil." But when it was pointed out to him that even the meanest plant that grows was not created in vain, he attempted to mend this definition, and doggedly asserted that a "weed is a weed, and everyone knows what that is." It would appear, however, that W. F. and one or two more from whom we have received communications on the same subject, do not know. We may therefore state, for their information, that the true definition of a weed is "a plant out of place." This only is a weed. There are no weeds in Nature's universal farm. The crop of this year may become the weed of next. Anyone who had grown a crop of potatoes and sown the ground with wheat will have had an ocular proof of this statement. When a man is hoeing mangels, everything that is not mangel is treated as a weed, and yet the hoer may be chopping down plants that constitute the crop in the next paddock or on some other portion of the farm. Weeds, then, bear no distinctive character as such, and plants only become weeds by the mere accident of position. The weed is treated as an enemy to the crop, but it is by no means such as regards the soil. Weeds, as we have before stated,—and it is to this that "W. F." takes exception—do not impoverish the soil. Any plant, as we have shown, may become a weed, but no plant can impoverish the soil except by the aid of man. Carry off the land on which it has grown any crop produced, whether it be for the use of man or only a "noxious weed," and the land becomes im-

poverished. Leave the so-called weeds to decay on the ground where they were produced, and the land is enriched by the decaying substances. Weeds do not waste fertility, as far as the soil is concerned; they are only detrimental and injurious as regards the crop intended to be grown. Let it not, however, be supposed for one moment that weeds should be allowed to grow because they do not rob the soil of its fertility. It is enough that they rob the crop of the benefit to be derived from the fertilizing matter intended for its support. Next in importance to the due and proper preparation of the land for any crop is the sedulous destruction of all plants that may appear, except those sown or planted as the crop, and all plants not sown or planted must be treated as weeds—because a weed is a plant out of place. The thistle is a weed on pasture land used by man for the depasturing of his flocks and herds, but in the wild waste by its growth and decay it yearly adds to the richness and fertility of the soil. Thus, all plants have their uses, and land after it has been improvidently impoverished by man, is taken possession of by inferior plants called weeds, which grow and exercise their utmost power to restore its lost fertility. But no cultivator who carefully manures his land can afford to grow a plant out of place, *i.e.*, a weed.

THE COMMON BRACKEN (FERN) AS A MANURE FOR COFFEE.

(Communicated to the *Ceylon Observer.*)

The following extract from Mr. Donaldson's *British Agriculture* refers to one of our most abundant ferns of the interior, which scarcely differs as a variety from the common bracken of Scotland, several times alluded to in the *Lady of the Lake.* It is so abundant on some of the patanas and other open ground near some of the coffee estates in the interior, and indeed in other places as a weed in the coffee, that the hints here given for killing it, and converting it into a good manure may prove of use to several of our readers. When speaking to a gentleman in Dolosbage about the means of killing this fern, he informed us that the villagers gravely told him the best way to do so was by thrashing it with switches—just as good a way as any other, because the plant ultimately dies like any other, if its fronds are thrashed to death, or cut off. The creeping roots die in this case for want of their lungs; but we believe the best way after all to get rid of it, if once it gets into a coffee estate, is to dig up the creeping roots (rhizomes)

and expose them on the surface or have them removed. A few cuttings of the young fronds close to the ground would no doubt also soon kill this fern.

"FERN."—*Farn-kraut*, German ;—*fearn*, Saxon ;—*filix*, Latin ;—is a plant of the cryptogamous class, and though the kind is numerous, only one vegetable comes under the notice of agriculture, the *Pteris aquilina* of botany, or the common bracken. It grows on soils of good quality, and is very generally diffused over heaths and uncultivated grounds. The roots spread horizontally and go deeply into the ground, and are often difficult of extirpation—frequent moving of the young plants, and ploughing and dunging have been recommended, and above all, the pouring of urine upon them—sheep folded on fern ground will banish them by means of the dung and urine. Fern has a salt, mucilaginous taste, and is used for thatch, for heating ovens, and mixing with bread, and for being brewed into ale. It is very astringent, and used in preparing kid and chamois leather. The ashes of ferns afford a large quantity of salt, about one-ninth of their weight, chiefly the sulphate and sub-carbonate of potash. One thousand parts of the plant cut in August and thoroughly dried afforded 36·46 of ashes, which yielded by lixiviation 4·5 of salt. 1000 parts of fern gave 116 lb. of saline matter, and 100 parts gave 3·224 of earths, 4·00781 of ashes, and 0·6259 of potash : 10,000 parts contain 62 of potash. Ferns are dried for being used as litter for cattle, and must be laid in the bottoms of the yards, and in very moist places, as they remain long unchanged. The organization must be completely saturated. The ashes are a good top dressing. The plants must be cut while green, as the alkali escapes from the withered plant by every shower that falls. Where ferns abound, a good litter may be got from them, and the dried plants may be cut into lengths by the straw-cutting machines which will much facilitate the reduction of the tough fibrous texture."

THE PROPER MODE OF APPLYING MANURE TO THE COFFEE TREE.

Delta, Pussellawa, June 30.

DEAR SIR,—The following remarks addressed to me by Mr. John Ward, a planter of 26 years' experience, are well worthy of insertion in your journal. I requested him to send me his views on the subject of "Surface Manuring," and sent him the letters lately published in the *Observer* for his information.

He seems of opinion that manure should be applied in large and deep holes, but the fertilizing substances must be *well mixed* with the soil. As planters' opinions seem so to differ on this most important subject, cannot you suggest some person who would set us right on these disputed points? Perhaps Mr. Thwaites of the Royal Botanical Gardens might help us, as he must be better able than any one else in Ceylon to explain scientifically the nature of the coffee tree and its requirements.—Yours faithfully,

WILLIAM SABONADIERE.

Extract.

"As you have taken the trouble to send me the letters which appeared in the *Observer* on manuring, I beg to say I do not at all agree with surface manuring, except only in the case where very light manure in small quantities is used. In such cases the stimulant should be very near the surface, or it is lost. I quite agree with you, that, under existing circumstances, the mean course that you speak of is the best to follow. Now I beg to submit a few remarks upon various parts of the letters in the *Observer*. Weeding with tools of any kind is of course bad, but what is to be done? The supply of labour is so irregular, that that question rules the one of weeding. Say what he will at other times, no man will deliberately lose crop, while he can save it by taking off his weeders; then the weeds get ahead, and there is nothing for it but using tools of some sort. As to deep holes for manure, you will be surprised to find that, theoretically, I would advocate two feet deep; and, strange as it may appear, and much as it may seem to war against "A Shuck Coffee Tree's" proposal to put the manure on the surface because Nature puts its there. I claim in my scheme to be strictly following, what Nature points out to be done. This is my reason. Nature provides the coffee-tree with a tap-root of two feet length. This tap-root is not merely to fix the tree in the ground, for every inch of its length and surface may be made by proper treatment to yield force and vigour to the trees above, by becoming *covered* down to the very tip with lateral roots. I should think there could not be two opinions about the superiority in every way of such a tree, over one possessing only a single disc of roots at the collar, which latter is the effect of manuring on the surface. You will probably say, manure at two feet depth, 'madness'; but here is where I would show the mistake that is invariably made in deep manuring, in itself the most correct plan, but always spoilt by never being completely carried out. I say then to give your coffee

tree the utmost advantage, put your manure in two feet deep, but *thoroughly mix with the soil every atom of it outside the hole before putting it in.* If this is done, the only limit to the vigour of the tree and crop on it, is the quantity of manure mixed and applied. Except in steep land, the mere size and depth of the manure holes, if done according to my theory, would cause the soil to be pervious and absorbent, that very little in the way of drains and water-holes would suffice for protection against wash; you know wash is worst on hard land. It is quite true that manure buried at one-and-a-half or two feet deep does lie quite useless, but if it was mixed with the soil the whole of that depth, it would be bringing out lateral roots all the way down the tap-root. "Orum" has evidently not practised the correct system of water holing, if he cannot stop wash by means of it. If only partially done it is no protection, but thoroughly carried out, and in conjunction with drains, it is quite safe. As to the effectiveness of surface manure, instanced in the case of the strong coffee near lines or cattle sheds, "Orum" does not stop to consider the enormous quantity of strong stuff that goes out imperceptibly in such cases; enough to manure three or four times the extent if properly put out. As to Nature designing trees to be fed on the surface, Nature feeds in that manner trees only, such as forest trees (for example) which are not required to produce and part with crops. Forest and all wild trees give little or no crop, but watch a fruit-bearing tree, even wild, and remark the depth and wealth of soil, and, no small point, the depth of roots, with which Nature has endowed it. There cannot be a doubt that cutting any large roots causes (according to the size of roots cut) the tree to dwarf and dry up.

Note by Mr. Sabonadière.—Allusion to deep holes remind me of the field upon Mousakella estate, Hewaheta, planted by Mr. J. Emerson. The holes were three feet wide and deep, and were filled with manure (whether mixed or not with the soil, I now forget) before the plant was put in. This coffee was most luxuriant, once or twice must have yielded over a ton an acre, and gave consecutive crops of 15, 16, or 17 cwts. an acre, and, though now some 18 or 19 years old, is still the finest coffee on the estate.

W. S.

SUB-SOIL OR SURFACE MANURING.

We shall sum up the further discussion which took place in the columns of the *Observer* during 1871 on Manuring—especially on the question of Sub-soil or

Surface Manuring—by making the following extracts. A superintendent gave his experience in favour of Surface Manuring as follows :—

"For the last six years I have manured the lower portion of the estate of which I have charge with pulp. Its lay is a gentle slope backed with steep face, the coffee being old more or less shuck. For the first three years I put the pulp into holes from one to two feet deep, with the usual fair results. But for the last three years I have applied the pulp on the surface, covering it over with a little earth, and with apparently very much better results in all respects. A rapid general improvement, a rush of young wood, a darkening in the colour of the leaf, and an increase of crop. Of course I took the precaution to drain the steep part, and I ought also to have hand weeded. Still if karandies did scrape away any of the pulp, yet what remained has done, as I have said, more good than if it had been all preserved in holes. I have this year applied one of our best animal manures on the surface, and already I see a far better effect than I did after burying the same kind of stuff in the orthodox way last year."

To him replied another experienced manager :—

"I am inclined, however, to think that a good plan would be, on estates manured, say once every three years, to apply the manure in deep holes one year, so as to induce feeding roots down the tap-roots; and near the surface the third year to form feeding roots there. An accurate account of this would of course require to be kept. But this, on estates where manuring journals are in use, would be very simple. I can't think it advisable to apply manure actually on the surface, be the land drained ever so well, as, no doubt, much is lost by wash and other causes. I have seen pulp applied as described by 'Superintendent,' and, though the land is carefully drained, yet I saw much washed into the drains and on to the roads: and of what remained any that was perfectly covered was dry and shrivelled, and this too in a wet district not 25 miles from Kandy, where we have not seen much sun lately. Let the manure be even put in holes 6 in. deep, and it will, I consider, be sufficiently near the surface, and can be covered so as to save it from being dried up or washed away. To apply manure as 'Superintendent' suggests, hand weeding is absolutely necessary: and there is no doubt that, though there are estates sufficiently clean to allow of hand weeding, yet there are many many more on which it is impossible to do away with karandies."

A still older planter favoured us with an analogous case to coffee manuring and some practical remarks :—

"I very much regret having mislaid Mr. Josiah Mitchell's letter on the orange groves of Paramatta, as the distinctive mode of cultivation there described, and only arrived at after 50 years' practical experience, struck me forcibly as the one best adapted to similar soils in Ceylon, cleared for the growth of coffee. To the best of my recollection the latter stated that the soil of the plantation in question, the finest orangery in New South Wales, was of the thinnest and poorest description with a free and open sub-soil; the mode of cultivation was to fell, clear, drain, and plant, as is done for coffee in this country, taking care to keep the ground free from weeds. When the time for manuring arrived, the practice, which for many years had been followed with the greatest success, was to loosen the soil round the trees to the depth of 2 or 3 inches, applying the manure to the surface. Several kinds of artificial manures had been tried from time to time with varying results. Superphosphate, I believe, was found to answer best, that is, it gave the most profitable returns, and at the same time maintained the trees in a vigorous state of health. It must not for a moment be supposed that because superphosphates acted so admirably on the thin poor soil of Paramatta the same manure will operate in a similar way on stiff land, or on land with a free surface only, but it may be safely inferred, I think, that land of a similar nature to that described would reap a similar benefit from this application of such manure. In fact the soil must be studied before we can by the aid of manure arrive at the desired result. I have little doubt at this present moment in Ceylon there are thousands of tons of the best fertilizers lying dormant in the soil, in other words, so many tons of manure *out of place.* Many are the varieties of manure I have applied in my time, and I am free to confess that in many instances experience has proved that the blame cast upon the manure, where no satisfactory results followed, ought strictly and properly speaking to have been thrown on its misapplication; but the possibility of such a thing never entered our heads at the time, consequently the manure was condemned, not as unsuited to the *soil,* but as unfit for *coffee.* In the application of stimulants, the object is to add to the soil that which it is in want of in the shape of a stimulant. In the application of such bulky manures as cattle manure, pulp, &c., the action is different: we not only add a stimulant, but we make a new soil out of the bulky ingredients applied. As to the mode of application of the different kinds of manure: so long as the land is protected by drains from wash,

I am in favour of surface manuring to a depth of 2 or 3 inches for all stimulating or artificial manures easily dissolved; for it stands to reason that, where the land is protected from wash, manure thrown on the surface, if it does not wash off the soil, must wash into it. Bulky substances ought to be placed deeper to facilitate decomposition, leaving it to the power of the sun's rays to bring their nutritous qualities to the surface to be carried down into the soil again by the first rays and taken up by the feeding roots."

Another gentleman, of much experience in cultivation generally, stated:—

"It took fruit-growers, in other parts of the world, much longer time than that to find out their great mistake in deep manuring. It 's only within 10 or 15 years the fruit-growers in England have found out by experience that surface and not sub-soil manuring is what suits their interests best. The system which they practice is to cover the ground around their trees with cattle dung in autumn, thereby serving the double purpose of protection from the winter's frost and enriching the surface soil. In spring the manure is removed to be replaced by a fresh supply or dug with a *digging fork* according as their trees require it. And every precaution is used to prevent the trees making tap or sub-soil roots (the handle of Mr. Ward's theory), and, before planting, the hole dug for the tree is half filled with stones or concrete. In some cases the bottom is laid with slate as close and regular as they are laid on the roof of a house, to prevent the possibility of a single root getting beyond the depth allowed. Mr. Ward appeals to Nature giving the tree a tap-root, as a reason why it should be manured. Looking at the coffee trees on our estates, can any one say that they are left in a state of nature? Is it natural for coffee to have its top lopped off when it reaches 3 ft. high, or to have its branches pruned and handled two or three times every year. Then, if we outrage Nature so much above ground, why should we follow a-tap root 2 feet below ground for no better reason than that Nature put it there? Much better treat the roots at hand well than go digging down encouraging the tap-root to send out lateral roots into holes dug by its side which (in higher wet districts with a retentive sub-soil especially) are simply recipients for water where dryness is most needed, and when a tap-root would be better dispensed with altogether. If more were done to prevent the roots going below half the depth proposed for the manure to be put, and as carefully tended as the branches are, there would be less need for manure and fewer short crops. But if the deep manuring

system be carried on it will be the old story :—' Well, it bore capitally when it was young so it did, but the roots are now deep in the sub-soil.' "

It gives us much pleasure to add a memorandum on Manuring by the Director of the Botanical Gardens, Peradeniya, in answer to an application made to him by a planter for his opinion on the vexed question of shallow or deep manuring :—

" It is true, as you state, that the coffee tree has a tendency to be a surface feeder to a very great extent: still, if the soil is suitable for it, a very large number of roots are found at a considerable depth. It is, of course, desirable to encourage the development of these deeper roots, as well as of the more superficial ones ; the plans has then more feeding space, and is, moreover, less liable to suffer from wash and draught.

" The application of manure just immediately under the surface of the soil would doubtless succeed very well under the following conditions :—

" 1stly.—The soil light and porous enough to allow the soluble portion of the manure to pass freely through it for the nourishment of the deeper roots.

"2ndly.—The surface of the soil shaded by the over-hanging branches of the coffee trees, or protected by a littering of mana grass or other vegetable matter.

" 3rdly.—Excessive wash provided against by a thoroughly good system of draining.

"If the above-named conditions are not present, I should recommend the manure to be applied in holes or trenches 1½ to 2 feet deep, narrowing towards the bottom. I would have the manure well mixed with the greater portion of the soil taken out of the holes or trenches, and this mixture after being thrown into them, covered up by the remaining portion of the dug out soil.

" As it cannot be supposed that there can be a very frequent application of manure to a coffee estate, it would seem desirable that, in this wet climate, a *slowly* soluble manure should be employed in preference to a rapidly soluble one, since much of the latter would probably find its way by filtration into the streams, instead of remaining gradually available for the nourishment of the coffee plants."

Another planter gave some good reasons for objecting to mere Surface Manuring in the case of coffee :—

" I object to put bulky organic manure on the surface, and I pointed out that coffee roots could utilise it even at a good depth. But I also object entirely to be called a 'sub-soil manurer.' It would take the juices of a lot of manure to make ordinary sub-soil wholesome for feeding roots, and these juices will in all cases do far more good absorbed by the better

soil of the surface. But to prevent the juices being washed away; to prevent the manure and rootlets in it from being dried up; to absorb the gases in hot weather; to allow the roots to grow over as well as into the manure; and for the proper rotting of the manure, it should be well covered. The looser and deeper the soil, the deeper may be the holes. In bad clay soils the holes would need to be shallow, but then the manure should be well covered by a heap of earth. Few will dispute that phosphates and mineral manures in general, when applied alone at least, should be put as near the surface as possible, so as to be kept moist and undisturbed. They can only do good to much purpose in connection with the organic matter of the surface soil. If mixed with plenty of organic manure they may be put deeper. The scientific fact that plants absorb carbonic acid and nitrogen by their leaves is of little account in cultivation or manuring. As to fruit cultivation at home, gardeners take means to prevent their finer fruit trees growing roots down into a bed, or wet and cold sub-soil by paving at two or three feet below the surface. No doubt they find advantages in this; and one would suppose it would be an advantage to have all the growth of root kept within the good soil. We have plenty of coffee growing over sheet rock, and lots of trees growing over flat rocks and stones of all sizes, so that their tap-roots cannot go deep unless they get beyond the stone. I have not noticed anything very striking about such trees, generally, except that they suffer more in droughts. So far as feeding roots are concerned, we have them all on the surface without any trouble, though perhaps in dry weather they would be none the worse of being deeper. With fruit trees at home they are apt naturally to extend too deep, the manure is dug into the surface, or forked in, to bring them up. This is a very different thing in many ways from laying manure on the surface on a coffee estate; and digging over all the surface in our coffee would destroy all the feeding roots at the time. The covering of the soil round fruit trees at home is to save the roots from drought and frost. The manure so used is fresh; and though its juices enrich the soil, that is not the object of its application. For us to use manure in this way would, I think, be bad economy; but we do something similar with mana grass, &c. We have to economize our manure so as not merely to produce fine fruit from a few trees."

A "Superintendent-Proprietor" next replied very forcibly to the criticisms against his "Surface," and in favour of "Deep-hole," Manuring:—

"All that we contend for is this, that wherever

surface manuring is practicable, then *that* system will *pay* better than the hole-cutting one. But if proper precautions be taken, such places will not be very numerous, and will generally be found as unsuited for hole cutting. However, the existence of such unsuitable places is no more an objection to the surface application of manure, than is the fact that some districts are unsuited for pruning, any objection to that work being carried on where desirable. High cultivation without manure ought to precede high cultivation with manure, and, if we don't want to waste money and time, there is little use talking either about 'Orum' or its application, till we have first drained, dug, and introduced hand weeding. Further, we have been recommended, excepting in very exceptional circumstances, to apply our manure not on the surface, but in deep holes, in order that the coffee tree may be persuaded to strike its roots deep down into the soil. Now as it is admitted that the coffee tree roots naturally prefer to spread out near the surface, this theory of root deflection must be somewhat opposed to their natural tendency. The reasons then given to induce us thus to cross nature, ought to be very strong indeed. What then are they? The first reason alleged is because the feeding ground will be extended. But cannot this object be obtained in some other and more satisfactory way. Instead of leading the roots down into an often cold, stagnant, airless sub-soil, why not simply dig and bring up portions of that sub-soil to the roots, and thus at the same time subject it to the improving influence of the sun and atmosphere. In its own humble sphere, do we not expect the coffee tree to do something better than search for food? The more we study its convenience, the less trouble we give it in administering to its grosser wants, the better will we find the grateful tree repay us in its higher labour, the production of crop. The second reason is because leading the roots down in search of the artificially supplied manure in the deep holes, keeps them out of harm's way being more or less protected against wash and drought. We need not now discuss wash, because there need be no wash. But as regards drought *does* deflection help the roots, that is the tree, to withstand drought, for of course to suppose that eighteen inches of hot dry soil will *perfectly* shelter roots from our droughts is out of the question. Or, take the converse. *It is a fact* that roots near the surface suffer more from heat and dryness than roots growing deeper down. Perhaps they may, if proper cultivation be not carried on. But wherever the soil is clean, surface manured and regularly forked, I believe they will not. Most

of us I fancy know how soon a thorough pulverizing of the soil is followed by a perfect net-work of roots spreading out just below the surface, and such roots if any, then ought, if theory be correct, to suffer most from drought. I have had no experience myself of low-country coffee, but a trusty friend supplies me with the following :—One season, when on a low-country estate, just before the hot dry weather set in, my friend took and thoroughly dug up a field. His neighbours, of course, seeing something new, thought him mad, predicting how the soil would be dried, and the trees burnt up. But the sun came and the rains ceased, and the plainly perceptible result was, that all through the searching drought the dug coffee looked far better than the undug, and the prophets were nowhere. The explanation of this perhaps is not far to seek. The occasional dews from heaven, the very moisture in the air, were readily absorbed by the friable earth, and the net-work of roots just below, eagerly drank up the precious moisture long ere the first gleam of sunshine could dissipate it. Irrespective however of explanation, we have here a fact, namely, that surface-growing root trees, under certain cultivation, did suffer less from drought than those whose roots grew considerably lower down."

Another planter tersely gave his opinion :—

"*Manuring.*—I don't believe in surface manuring as a rule (except the roots of the trees appear above the ground from wash, &c.), nor in cutting deep holes. In flat land scrape off the soil off the roots all round the tree which is quite enough, the more roots uncovered the better, if there be manure to spread over them. In steep land a certain size of a hole is necessary, but by no means cut the roots. Artificial manure, if possible, ought to be applied on steep land, and in this case cut a long hole (but does it deserve the name of hole) half round the tree from 4 to 6 inches deep *down* to the *roots,* not a small scratch, but let the manure be spread over as many *roots* as possible. In steep land bulky manure won't wash away if well drained, which it ought to be : make the hole long, round the tree from 2 to 3 feet and from 6 to 8 inches deep, and cover up the manure from the atmosphere which is of great importance. All manures should be covered up, as there is a deal of waste otherwise."

While the "Shuck Coffee Tree" declared that "Surface Manuring" was indispensable on high, whatever it might be on low estates, the gentleman experienced in home cultivation returned to the charge in favour of surface manuring for coffee as for fruit trees at home :—

"I am well aware that covering for protection is and must be extensively practised, but that is quite a different thing from manuring, and the materials used for that purpose are fresh enough in all conscience, being seldom anything better than half wet straw, and as often grass, leaves, branches, in fact anything come-at-able that will answer the purpose, and which serves exactly the same end as mana grass spread amongst coffee, and I suppose every one knows how much the juices of mana grass enrich the soil. But the manure, which is spread on the surface as a manure, is well-rotted cattle dung a year old at least and allowed to lie on the surface till it has served the purpose for which it was applied, when, if the soil be such as become hard or caked, what remains of the manure is mixed with the soil, more to keep it open and to admit other influences than for any good the tree can derive from the bleached manure. I never heard it disputed, but that rocky land generally was best for coffee, and I have seen coffee growing on sheet rock with not more than a foot of soil, hsving less soft spongy wood and invariably a few more berries than their neighbours who were rejoicing in all the glory of tap and sub-soil roots. And I have seen trees with not more than 6 in. of soil giving more crop than trees twice the size differently situated. I have examined old coffee, which for several years had given very little crop though manured, and looking well, annually showing lots of blossom, and found the roots to the depth of a few inches numerous and healthy, below that they were less numerous and appeared unhealthy, entering the subsoil in every direction, more especially downwards. I have looked into the 18-inch holes where two years before a basket of good cattle dung had been put and found at the bottom a thin layer of black stuff with a few roots looking very rueful indeed at being forced to seek their food in such unkindly quarters."

Another planter very properly says that one great secret in applying manure is to have it thoroughly mixed with the soil. Some very suggestive remarks sent by Mr. Thwaites, Director of the Botanic Garden to Mr. Sabonadière may be given here :—

"It is a great pity you cannot devise some plan for keeping your land pretty much as you get it from the virgin forest, but in the first place by burning, you get rid of an immense amount of valuable plant-nourishment on the trees and upon the ground, and then you lose still more by the wash from the surface during rain. Nature manages much better in her plantations. By her the soil is protected from being washed away by a pavement of fallen leaves,

when the previous ones have nearly disappeared, adding at the same time valuable manuring matter to the soil, returning indeed the greater portion of what the tree-growth has taken from the soil, in addition to the carbon compounds the foliage has been deriving from the atmosphere. It is true that after burning and clearing you have a good deal of vegetable matter in the shape of tree roots remaining in the ground, but this disappears in a short time, and you begin to run short of vegetable mould a manure so desirable for such plants as the coffee, which I suspect grows on the margins of forests, as so many of the tribes do. It is saddening to contrast the large amount of invaluable soil washed from a coffee estate into the drains and streams, and the insignificant quantity of soil which the rain dislodges from the virgin forest. A great deal of this waste of precious soil might be prevented, it seems to me by a proper system of littering, combined with good drainage arrangements." In another letter Mr. Thwaites observes, in reference to a letter asking his opinion on planting estates and letting the trees grow to their natural height :—"I fancy that the present planters' system will hold its own at elevations above 3,000 feet, as regards distance apart of the trees and their pruning, but the wash should be prevented, and at the same time supplies of vegetables mould be furnished to the soil, to prevent the *wearing out* of the estates, which must be taking place under the present system. Communications to the newspapers are sometimes read hastily and often misunderstood, and then referred to as advocating something entirely different from what is stated. For example, any one reading the letter of 'Shuck Coffee Tree' in the last *Observer* would suppose that I had recommended manure to be buried two feet deep, whereas by my plan the larger portion by far would be from near the surface, to half the depth."

"As regards littering, I can myself," says Mr. Sabonadière, "testify to the benefits effected by thatching with mana grass, and no doubt it would pay well to use the virgin soil from the forest for manuring purposes, lucky those, therefore, who have any reserve forest to fall back upon. As regards draining, it should be commenced at once an estate is planted, and the trees should be encouraged to cover the ground. This is partly the reason why shuck coffee near lines is always so fine, and above all weeds should never be allowed to get in, so that there would be no necessity for scraping the surface soil. Let our young planters take a lesson from the experience of others, otherwise it will be the case with Dimbula and Dik-

oya, as in other old districts I could name, but which politeness bids me leave to be guessed at by my readers. I believe that planting under shade would answer very well at low elevations."

A planter, of sixteen years' standing, gave very suitable suggestions for young planters :—

"Early last year, I had an old set of lines to pull down on a spot where I wished to erect permanent ones. And not very far off, I had a very seedy knoll of coffee, quite an eye-sore in fact. So I tried what I frequently did before in other districts. Put all my women and children on: pulled down the old lines; and spread the débris on the *surface* of the ground where this aforesaid shuck coffee was. The result is, I am now handling the same coffee, and so luxuriant is that patch of *shuck coffee* that my men cannot handle more than 80 to 85 trees a day: and I believe it will bear (without suffering) over 10 cwts an acre. The patch I mention is on steep land and not over well-drained. I have tried the same in several districts; both high and low and always with the same result. I need scarcely add, I believe most thoroughly in 'surface manuring' and drains (in preference to any) combined with hand weeding: and I have tried manuring in almost every shape."

A planter of twenty-five years' experience in favour of holes two feet deep on steep land, shewed that although two feet as regards the trees above, the holes would be much less with reference to the trees below. He also attacked most vigorously the system of dibbling instead of holing before planting coffee, and believes the former most unsafe. Another planter favours us with the following extract referring to the use of Salt and Lime as manures :—

"Extract from *Gardener's Assistant*:—Common salt has been long employed as a manure; and in moderate quantity, and on certain soils and situations, its use has been attended with very beneficial effects. It is well known that salt, when used in large quantities, proves destructive to vegetation; accordingly strong solutions of salt are frequently employed for the purpose of destroying weeds. Land situated near the sea, and which is exposed to sea breezes, always contain a quantity of salt. In islands and countries situated near the sea, salt is always of less value as a fertilizer than elsewhere. Salt is generally used as a top-dressing (5 to 10 bushels per acre) and sown by hand in which way its more even distribution is insured; it may also be advantageously mixed with earth and lime, or with soot or other manures."

"Lime is very advantageously employed in form-

ing composts with ditch-souring, earths, weeds, &c., as it hastens the decomposition of the vegetable matters, liberates alkalies, destroys the vitality of seeds, roots, &c., and kills vermin, besides itself contributing to the fertilizing effects of the mixture."

Mr. F. Pogson, of the Punjaub, writing to the *Madras Times*, on the subject of manures for coffee, made the following remarks :—

"What coffee requires is a compost which will easily dissolve in water (after being applied as a top-dressing to the soil), and so be carried down within reach of the roots and rootlets of the growing plants. It may perhaps not be generally known that the best manure for a plant is a solution of itself ; and as this is not always forthcoming, the next best manure is an imitation thereof or a something which contains the elements or constituents of that plant; and as these are chiefly mineral matters, which are present in very small quantities in cowdung, it is unreasonable to expect first-class coffee berries from leaf-forming properties. We know from analysis that the best 'Java coffee' is remarkably rich in magnesia, of which cowdung does not contain even a trace ; and as a consequence the growing coffee plant suffers from the deficiency. The common salt and sulphuric acid so largely present in coffee cannot be provided by cowdung, nor yet can it supply the very large quantity of potash needed by the leaves and berries of this plant.'

Mr. Pogson then professed to be able to show how such a compost could be made readily and cheaply in Ceylon, where the components are abundant—if he were sufficiently rewarded. But his plan has not as yet been made public. He added :—

"I give beneath an analysis of coffee from which you will see that unless the mineral matters named are present in the soil and manure, good coffee cannot be produced. The deterioration of coffee plantations is due to the plant having exhausted the soil from constant cropping without proper manuring :—

Analysis of best Java Coffee (*Lehmann*).

Potash	51·17
Lime	3·58
Magnesia	8·67
Peroxide of Iron	0·25
Phosphoric Acid	10·02
Sulphuric Acid	4·01
Silicic Acid	0·73
Carbonic Acid	20·00
Salt, Culinary	1·08
Soda	0·00
Charcoal and Sand	0·49
	100·00

A Ramboda planter gives some "interesting particulars" on the subject of manuring:—

"I disapprove of applying stimulating manures to soils that only need feeding, and feeding manures where only some minerals are needed to throw loose the nourishing ingredients native to the soil. "Orum" is again right in the matter of applying manure to the surface. A great deal of manure has been lost by being put deep in the ground, and how such a sensible man, as 'Orum' appears to be, should not agree with me about wash-holes, I cannot understand. Why should 'Orum' not apply his drains to the field with wash-holes as he did to the manured one? And let me give him a *wrinkle* in surface manuring: let him apply his basket of manure or his pound of compost, well spread round the root of the tree, and then send his holers to cut a shallow hole, say 2 feet by 2½ feet and 6 inches deep, between every alternate tree, throwing the earth taken out of the hole on the top of the manure round the roots of the two nearest trees, covering the manure thoroughly with it, and then see to good drains being cut, drains not 1 in 17 as 'Orum' prescribes, but say 1 in 12, and it will be possible to keep them open. In the case of drains with a gradient of 1 in 17 it is hardly so.

"A drain bursting near the top of a field, (and drains of the gradient intended by 'Orum' are apt to do so,) will choke up all drains to the bottom of the field, and then matters are worse than if there were no drains; but with your manure well covered round the roots of the trees, and your water-holes, formed by cutting out the earth to make this cover, ready to collect all weeds, leaves and prunings, with drains 1 in 12 well cut, and cleaned out regularly along with the weeding, your manure will be at peace. No harm will result from roots, or rather rootlets, being drawn to the surface: indeed I think little is to be feared from this, for manure protected from wash and evaporation, as all manures should be, will soon sink deep enough, creating rootlets as it goes. I am sorry to disagree with 'Orum' about the wash-holes, but I think them an essential part of a well-cultivated field, not so much for the sake of preventing wash of earth, which can be better done by thorough draining, but to prevent waste of vegetable matter such as weeds, leaves, prunings, and any kind of vegetation that may be about, and these, when husbanded in this way, with the little earth that will always be washed in with them, make the very best of manure, in my opinion.

"A wet season or rather a succession of wet seasons must be injurious to soils like Dimbula and

Dikoya, where the want of stones to create a natural drainage and a stiff sub-soil prevent the water from sinking down so fast as is required, and its accumulation in the sub-soil sours it. Soil, occasionally wet and occasionally dry, will improve in quality, turning blacker and more friable, while soil kept continually damp will turn into stiff clay. So the want of sub-soil drainage must be injurious to the coffee tree. At first sight Mr. Corbet's plan of furrow draining (for it is evidently furrow drains Mr. Corbet means) seems the right thing to do. I have often thought of furrow draining, and thought how good a thing it would be to furrow-drain a stiff-bottomed field, and have even tried it on a small scale, but, as I expected, could not afford to do it with coolies. Coolies do most things necessary on a coffee estate cheaper than European labour could accomplish the same task in their own country, most kinds of works at 50 per cent less than such works would cost in England; but not in cutting deep drains, that is a kind of work coolies will never be able to do at a reasonable rate. Furrow draining is thoroughly understood in England and Scotland, in Scotland more especially, and in furrow draining some rules are thought absolutely necessary to be followed—in all kinds of furrow draining—to insure their answering the purpose for which they were intended, viz., the sub-soil. The first of these rules is to place the drain up and down the hills and not across it, as by placing the drain across the hill it will leak as much by the under side as it will drain from the upper. The second rule is that the depth shall correspond with the distance apart, 4½ feet is considered sufficient for drains 14 yards apart. The third is that the drains be properly *filled in*, the bottom being provided with small stones, tiles, timber, or whatever may be considered most expedient, that not being considered of so much consequence as the careful covering of the under layer with broken metal and over that a thatch of some kind to prevent earth from getting into the drain; water only may drain in below, but over this water must be prevented from getting into the drain by the surface, and to prevent this properly-worked clay must be put over the thatch and properly beaten down, and then the cutting filled up with earth rammed down, and the remaining earth spread over the field, and the furrow drain may be said to be finished. But another rule is, that all furrow drains be emptied into a leader properly built and not into any open ditch.

"These rules will have to be complied with to ensure success in draining. And what will be the cost? An acre of coffee will require about 200 yards of

drains, and a cooly after some experience (he need be a 10d one) will cut about 1½ yard a day; 133 days at 10d—£5 10s 10d. Filling in will cost—collecting stones or timber 1½d, preparing and putting in 1½d, claying and filling in 1½d=4½d per yard filling in, or per acre £3 15s, and then 24 yards of leader drain will cost 1/6 per yard, £1 16s in all, £11 1s 10d per acre. You may say you can do it for less and can dispense with filling in, but unless the drain is kept properly clear it will not act, and if it be possible to keep a furrow drain clear without covering it it will be at a cost which would soon cover the expense of filling in high as it is. If draining could be done properly at a fourth of the money, then ye men of Dimbula and Dikoya do it, but I do not suppose you are prepared to spend from £13 to £14 per acre on it. Cutting drains three feet deep, and leaving them open, will be so much money thrown away, except for surface. Instead, as transport from Colombo gets cheaper, send for *quicklime: lime* mind you, not chunam, which is little else but magnesia, good medicine some times, but indifferent manure, and apply the lime immediately after it is slacked,—see they do not do that for you in Colombo,—apply it to the surface and to the tree. Liquid manure, that's the thing when cart roads are at reasonable distances apart, and a small cart road will be sufficient for the purpose. It can be applied at half the cost of cattle manure and with greater benefit. So cut cart roads, build sheds, buy cattle, and plant grass. Build a tank to hold 5,000 gallons [illegible] buy four 60-gallon casks, build four small carts to carry them, taking down your 6 feet spouting, and add a hook, and a few links of chain, and then convert all your manure and all convenient animal and vegetable matter good for nothing else into liquid with vitriol and water or anything else you can do it with, and then with one cooly to scrape a small hollow round the tree to hold a gallon of water to be sent down by measure from the cart, and another to shift the spouts to another line of coffee as they have done their duty, and other two coolies to attend to the cart and bullocks. These four coolies will manure half an acre per day. You will be able to calculate the cost and see how small it is. Manure applied in liquid will go much farther than when applied in bulk, and by making all your cattle manure into liquid, keeping cattle will pay."

Mr. W. Cross Buchanan has given his views on the subject of manuring, and especially on the value of artificial and other manures, in a letter to the Planters Association, as follows:—"Within the last three

years I have had many opportunities of testing the merits of different artificial manures, and I find, from personal experience chiefly, that the use of artificial manures alone is undoubtedly very prejudicial to the coffee trees on old estates. I have seen isolated instances where no bad effects have accrued as yet from the use of bones and poonac, but they are so few in number, that I have no hesitation in advocating great caution in the use of such stimulants *alone*. At the same time, when mixed in certain proportions with any bulky vegetable matter decomposed with cattle manures and pulp, they constitute in my opinion the sum-total of economical manuring, giving to the tree all that robust and vigorous appearance as if cattle manure alone had been applied, produce good steady crops, while the tree does not suffer at the end of the season, as is the result when artificial manure alone is used. If an estate be capable of manuring say 30 acres annually with cattle manure and pulp, the quantity so used would, if mixed with a combination of artificial manure and any vegetable matter, be sufficient to manure, in my opinion, 90 acres, at no increase in the relative cost per acre, while the compost would not be in any way inferior to the cattle manure and pulp by themselves.

"Superphosphates of lime, castor poonac, special mixtures, sombreorum, and other manufactured manures, all excellent and powerful fertilizers, ought, if applied to old coffee, to be treated in the same manner as bones and poonac. To hope to renovate old [illegible] altogether without bulky manures is both against theory and practice, but by all means try and reduce the quantity to a minimum. Not many years ago I saw three to seven baskets of rich cattle dung thrown into each manure hole, and this done by two of the oldest and most experienced planters in the island. The treatment of old and young coffee ought to be very different as regards manuring. Take two fields of coffee growing on the same slope and soil,—one 26 years old, the other rising seven, we find the young coffee with roots *all entire* taking strength from all parts of the soil equally around, and the soil itself giving out a fair supply of nourishment. On the other hand we see the old coffee with roots partly bared by the weeding scraper, washed by the rain, portions entirely cut away by the mamoty, and the soil impoverished by constant cropping. Admitting those two fields as fair average of old and young coffee, it seems to me that the action of the trees upon the manure would be very different. The young tree would not require to depend so much upon the manure to ripen the crop as the old,—surrounded as the latter

is with worn-out soil, and partially covered roots naturally requiring a more substantial manure than what would suffice to ripen the young wood and increase crop upon the young tree. From this I infer that artificial manure may in many instances be used alone with impunity and with success on *young* plantations for a few years, or as long as the soil itself is not exhausted.

"With regard to the *method* of application, the kind of manure used, the general features of the ground and appearance of the trees will show at a glance to any practical planter the best course he should pursue. The nearer the surface, so long as the manure is sufficiently covered to prevent waste and the effects of the sun's heat, it will, I believe, show quicker results; but I should strongly oppose anything like surface manuring, as being impracticable and unsound in theory. It is more than probable that, after a little time, manuring in the centre of the square will become very general on young estates, especially as holing at the upper side of the tree has the effect of making the roots tend to one side, whereas holing in the centre of four trees prevents the cutting of large roots and tends to the free and longest growth of the root."

THE FERTILITY OF SOILS.

In a recent letter to the New York Farmers' Club, Professor S. W. Johnson, of Yale College, says:—"The labours of chemists to discover positively all the causes of the fertility of soils have not yet met with conclusive success. The mechanical structure of soil is of primary importance. Naked rock grows lichen; the same rock crushed into coarse grains grows a much higher order of vegetable; pulverized fine, the cereals grow in it. Geology, chemistry, botany, physiology, meteorology, mechanics, hydrodynamics, heat, light, and electricity are all intimately combined in the grand process of vegetation. There are sandy soils in our Eastern States which, without manure, yield meagre crops of rye and buckwheat; but there are sandy soils in Ohio which, without manure, yield on an average eighty bushels of Indian corn an acre, and have yielded it for twenty to fifty years in unbroken succession, the ingredients of these soils being, by chemical analysis, the same. At present no difference is known between them, except the coarseness of the particles—the first being coarse, while the Ohio sand is an exceedingly fine powder. The power of soils to attract and imbibe moisture

and oxygen, was well shown by Schubler, of Hoffen, forty years ago. Of thirteen different soils, quartz sand absorbed in thirty days 1·1000 parts of oxygen and no moisture, while humus absorbed thirteen of oxygen and 120 of moisture.

"SURFACE water that flows off the land instead of passing through the soil, carries with it whatever fertilizing matter it may contain, and abstracts some from the earth. If it pass down through the soil into drains, this waste is arrested.

[The principles above enunciated exemplify the difficulties of coffee planting. We cannot plough and harrow the soil so as to pulverize it and expose it to the action of the atmosphere, nor can we build sunk drains to receive water filtered of its fertilizing materials by the earth. But by means of manure and water holes, and forks to puncture the earth, we can do a good deal to bring inert soils into action.—ED. C. O.]

NOTES ON MANURING.

Dr. Sortain, of Batticaloa, favoured the public with the following valuable Notes during the discussion on Manuring :—

1.—There are two classes of elements which are necessary to every soil to ensure the growth and fructification of vegetables—mineral and nitrogenous.

2.—The former exist in every soil, but not always in an available state; the latter are supplied by the atmosphere, but seldom in quantities sufficient for cultivated crops.

3.—The mineral elements or the alkalies make up the bulk of all soils; even pure sea sand contains every mineral necessary to the growth of plants.

4.—If a quantity of pure sand be placed in a bottle of water saturated with carbonic acid, after a time the water will be found to contain various alkalies in solution.

5.—Virgin soils are fertile on account of their available alkalies, which have been brought out of the latent state as it were by the prolonged action of the carbonic acid supplied by the decomposing vegetable matter.

6.—Soils differ in the facility with which they yield to the action of the carbonic acid. Sea sand for instance and volcanic matter are fertile accordingly.

7.—The soils of Ceylon are generally the débris of hard rock—and their stores of available alkalies are easily exhausted.

8.—The humus, or vegetable matter in the soil, will

also fail in due course, and with it the supply of carbonic acid, and the alkalies will remain latent.

9.—One object of manuring should be to keep the soil well stored with humus, and that will ensure a good supply of available alkalies.

10.—Where fruit is the object of cultivation, nitrogenous manures are necessary; the mineral elements alone, however abundant and available, will not ensure fruit.

11.—Without a due supply of alkalies the *tree* will not flourish, and nitrogenous manures alone will soon render the best soil barren.

12.—The method of applying these principles will vary according to circumstances. Nature should be imitated as much as possible; the whole bulk of the soil should be supplied with the two kinds of manures, so that the whole mass of the roots may perform their vital function.

13.—The application of manure to land bearing annual crops is easy; but if trees are cultivated, the extent to which their roots may be prudently disturbed must be considered.

14.—Humus absorbs and is highly retentive of moisture, so that the more a soil contains the less is it likely to be affected by drought.

15.—The best season for the application of manure is a very important question; if the roots of trees are cut during *dry* weather, their supply of moisture is curtailed; if nitrogenous manures are applied *too* shortly before the heavy rains, their soluble matter is liable to be carried away.

By humus is meant the vegetable matter that has decomposed and become part of the soil.

By alkalies—the parts of a plant not dissipated by burning.

16.—With regard to practice upon the above principles, my opinion, founded upon observation, is that a supply of available alkalies should be kept up by the regular application of *vegetable* matter; the soil will then be always ready to receive and make the *most* of the nitrogenous or fruit-forcing manures.

17.—Manuring is not the only method by which the fertility of the soil may be kept up or restored, good agriculture will take advantage of the elements of fertility supplied by nature.

18.—Rain carries with it much carbonic and nitrogenous matter, which it yields up to the soil to the extent of their absorbing power.

19.—The absorbing power of soils varies according to their chemical compositions, their texture, and the depth to which the rain can soak and pass freely through.

20.—Soils absorb the gases brought to them by the rain in a definite degree: when saturated they will take up no more; it is evident, therefore, that the deeper the bed of soil in which the roots seek their food, and the more perfectly it is permeable, the greater the amount of fertilizing matter which will be left behind by the rain.

21.—This bed of surface soil may be deepened *by draining*, by which the line of stagnant moisture is lowered, and by encroaching upon the sub-soil, by methods known to agriculture.

22.—If the 80 or 100 inches of rain in Ceylon could be enticed to soak through the soil instead of running off, no fruit-forcing manure would be necessary. The intention of good agriculture should be to accomplish this as far as possible.

23.—The power of water to fertilize depends upon the presence of nitrogenous matter either in it or the soil to which it is applied. Spring water, and river water also, to the extent that it has filtered through the soil, have parted with their nitrogenous matter. Stored water also gradually loses its value, for it rapidly yields up its nitrogenous matter to the animal and vegetable life that abound in it. River water is but partially successful when applied to coffee land, and old tank water renders paddy crops feathery.

24.—This relative value of rain and river and tank water should not be lost sight of when discussing irrigation schemes that involve great outlay.

SECOND SERIES OF NOTES.

1.—There is a scientific idea which, if popularized, might be of service in the discussion of coffee manuring, it is chemical absorption.

2.—When water is applied to perfectly dry earth a certain definite portion is absorbed and becomes latent; beyond this point the moisture is sensible. Ordinary drying by sun and wind will drive away the sensible moisture, but it requires a high degree of heat to drive off the latent, or, as it is called, the water of absorption.

3.—Gases, as well as fields, are subject to this law of definite absorption.

4.—When the food of plants is brought to the soil by rain, the upper layers absorb it up to saturation. What is over is carried to the lower layers and there absorbed, and so on, as far as the soil is permeable, down to the stagnant moisture. If there is more than enough to saturate the whole, it passes off to waste, as far as the soil on which it fell is concerned.

5.—If, however, the rain cannot pass freely off as in swampy lands, it stagnates; and when, as the

season changes, the water is evaporated by sun and wind, the fertilizing matter is left behind in the soil not chemically absorbed but in solution in the sensible moisture.

6.—This fertilizing matter, as the ground dries up, is given up to the atmosphere and renders the country unhealthy. When land is drained it becomes fertile and malaria disappears; the fertilizing matter can now be chemically absorbed by the soil.

7.—When organic matter is left to decay on the ground, rain takes what is soluble down into the soil, where it is absorbed up to solution. This is the way in which wild vegetation is supplied with fertilizing matter, and, as the whole mass of roots derive the benefit, it is the best way, provided the fertilizing matter is not dissipated in the atmosphere, or carried away by floods.

8.—The vital force of the rootlets is able to overcome the chemical force of absorption, and due exercise of the function increases the power of the tree to take up its food, as muscular exercise increases muscular power, and a good digestion is better than a good supply of nutritive soups.

9.—As the soluble products of decaying vegetable matter are carried down into the soil by the rain, as also the roots of the trees excrete effete matter, and as the rootlets themselves are shed like the leaves, the humus, though being constantly used up, is as constantly supplied.

10.—Terracing, tile draining, surface manuring, and thatching, appear to me the best methods of cultivating coffee, as far as the soil is concerned. The first two are expensive certainly, but then the present chena method cannot go on for ever.

11.—Terracing should be accompanied by draining, for the water having soaked through the upper terraces will have lost all value, and should be let off at the sides.

FERTILIZING SUBSTANCES FOR CEYLON COFFEE LANDS.

(From the *Ceylon Observer.*)

Our best thanks are due for a copy of the Report for 1870-71 of the Ceylon Planters' Association. Amongst information of a useful nature on subjects which have been already discussed to a more or less extent, we are surprised to find, for the first time published, a lengthy and most important contribution to our knowledge of the chemistry of that branch

of agriculture which constitutes the main material interest of this colony. Proceedings of Committee Meetings of the Association were formerly held sacred from publication, a rule more honored in the breach than the observance. The result of the restrictive rule (no longer in force), is that we only now are aware that, at a Committee Meeting held so long ago as 20th June 1870, "Mr. Harrison mentioned that, in accordance with the request ot the Committee, he had selected samples of soils, coffee, &c., from various estates and forwarded them to England for purposes of analysis. He then read a paper descriptive of the various samples sent." The analysis of soils made by Dr. Voelcker a year ago (he does not seem to have thought it necessary to report on the branches, leaves, and fruit sent to him) are published, with the opinions of that eminent agricultural chemist as to the best substances for application to such soils and the proportions of each. The soils were of all qualities, taken from estates of varying ages and at different elevations, and Dr. Voelcker prescribes for each typical case. This contribution to the literature of coffee culture is therefore of general and great importance, fully justifying the space we devote to it. We intended to have drawn attention in detail to the main results established, but space to-day will not permit. For the present, therefore, we can only say that Dr. Voelcker's analyses confirm the results of previous ones as to the wonderful similarity of the coffee soils of Ceylon in all the main constituents: organic matter, oxides of iron, alumina and insoluble silicious matter.

The great problem is to ascertain the proportions in the soil of,—*first*, PHOSPHORIC ACID; and *second*, POTASH. A few decimal parts of these essential elements deficient or in excess make all the difference between sterility and fertility; and on the proportions ascertained depend the quantities which should be applied to the soil of *first*,—*good* MURIATE OF POTASH (the imported potash of commerce, muriate and chloride of potash meaning just the same thing), containing 80 per cent of pure muriate of potash; *second*,—*fine* BONE-DUST; *third*,—*good* SUPERPHOSPHATE OF LIME (bones treated with sulphuric acid the best form), containing 25 per cent of soluble phosphate; *fourth*,—*good* SULPHATE OF AMMONIA. In one case alone is nitrate of soda (the form of saltpetre most allied to common salt) recommended, and with Dr. Voelcker's verdict, that it is evanescent and liable to be washed away, while, being in demand, unhappily, for the manufacture of gunpowder, it is far more expensive than muriate of potash, we may dis-

miss it. Four-fifths at least of what the eminent agricultural chemist considers the most efficacious manure for coffee must consist of potash, bone-dust, and bones in the shape of superphosphate; while the sulphate of ammonia added should never exceed one-fifth. In four out of six recipes indeed given by Dr. Voelcker, the proportion is only 15 per cent. The proportions applied as Dr. Voelcker states of the fertilizing salts he recommends must depend on the condition of the soil as revealed by analysis; but even where analysis cannot be obtained, any planter would be safe in applying a small dressing of the substances named to good soil (say 3 cwt. per acre) so as to keep it good; and a larger dressing (say 5 cwt. per acre) with about an equal quantity of poonac to fertilize poor or restore exhausted soil. The application, to secure the fullest results, ought, we learn from a planter of experience, to be made annually, but once in two years would keep coffee fairly in heart. A most important point to be remembered is that every cwt. added to the normal produce of an estate is almost clear profit. It follows that, if by adding 3 cwt. per acre annually of manure the yield is raised from 5 cwt. to 7, 8, 9, or 10 cwt., the immediate profit will be large, while the land will be kept permanently in good condition. The cost of 3 cwt. of Dr. Voelcker's mixture ought not when applied to reach £3, while 2 cwt. *additional* of coffee ought to realize £6 to £7 gross, of which, according to our authority, a very large proportion would be profit. Can any of our readers favour us with an analysis of castor-oil cake, so that we may be able to see *why* it is so much better than coconut poonac which we know yields to analysis the elements of coffee? Dr. Voelcker, the man of science, attaches far less importance to organic matter than does the merely practical planter Mr. Taylor. Organic matter is of great importance, nevertheless; but as fallen leaves, though they contain the minimum of fertilizing salts, are yet most efficacious in securing the action on soil which results from warmth and moisture. In the soils examined by Dr. Voelcker, the proportion of organic matter varied from a minimum of 5·07 to a maximum of 13·13; oxides of iron from 2·64 to 12·84; alumina from 6·01 to 16·47; while insoluble silicious matter proved to be never below 59·57 (alumina being in this case high in proportion), rising to 82·23. Our soil consists of about 98 per cent of the organic and mineral substances named, with not much more than traces in each case of such salts as sulphate and carbonate of lime, magnesia, phosphoric acid, potash, and soda. In the very best soil

we get ·30 of phosphoric acid and ·27 of potash. Such soil would grow anything; but what could be expected from another soil shewing only ·02 of phosphoric acid and ·04 of potash? This was a dark patana soil, and, although it looked well, did not, of course, grow coffee well. Even the richest manure would probably be thrown away in this case, unless the ground were first well stirred up and left for a couple of years to be aerated. The great desiderata seem to be simple tests for phosphoric acid and potash, which any superintendent could apply. So long as a soil is found to contain appreciable quantities of each, it will grow coffee well and require but a moderate expenditure for manuring. If phosphoric acid is so low as ·10, and potash down to ·15 per cent, then only heavy manuring with potash, bones, superphosphate, and ammonia, with or without poonac, pulp, &c., will enable the soil to yield good crops of coffee.

THE NECESSITY FOR TRIALS OF DIFFERENT MANURES AS THEY MAY SUIT SOILS is thus indicated by one who has devoted his life to scientific agriculture:—"Whenever," says Mr. Mechi, "I use an artificial manure, I leave a portion of the field unmanured with it, and am thus enabled to judge by the crop if I am remunerated for the outlay. So various are the soils and conditions of each field that such a comparative test becomes absolutely necessary, for where the whole field is manured and no portion left undressed, no just conclusion can be arrived at. On this farm I have frequently applied bone dust, superphosphate, blood manure, and other artificial manures, without the least increase of crop, while Peruvian guano, and especially our shed manure are always profitable. As I know that on many farms such manures have been found very effective, there must be causes that render them inoperative on this soil. No doubt shed manure, resulting from animals fed with corn, cake, roots, and hay, malt-combs, and bran, contain all the elements for every crop. Possibly it may be that, having thus enough phosphates, the addition of more is not required or availed of by the plant. At all events my case proves the necessity for comparative trials."

THE COST OF ARTIFICIAL MANURES.

The following analyses and calculations of cost of several descriptions of manure may be worth inserting for the information of coffee planters. They have been lying among our papers for some time, having

been furnished by an experienced farmer in the North of Scotland, as referring to artificial manures which he had used with satisfactory results on his land. He, and his brethren, had proved after a good deal of costly experience, that they could never depend on the qualities of the artificial manures received from the large manufactories. The increased demand was soon found to lead to very extensive adulteration. Some of them accordingly formed a company, erected the necessary machinery at considerable cost, and, importing the raw material direct from South America and other places, proceeded to manufacture not only for their own use but for that of the farmers in the surrounding districts. Our visit to the manufactory was a very interesting one, and it was then (some three years ago) that the following figures were furnished as the analysis and cost (delivered at the manufactory close by a shipping port) of some of their principal artificial manures :—

Names.	*Analysis.*	Cost per ton cash.
No. I.—Bones.	29·96 of Solub'e Phosphates 14·34 „ Insoluble do 2·51 „ Ammonia	£7 10
No. II.—Bones and Coprolites.	24·44 of Soluble Phosphates 13·36 „ Insoluble (changed after) 1·12 „ Ammonia	£6 10
No. III.—Superphosphate—Bone Ash.	36·25 of Soluble Phosphates 8·64 „ Insoluble do Nil Ammonia	£6 10
Mineral or Coprolites.	26·32 of Soluble Phosphates 6·52 „ Insolub e (Stationary) Nil Ammonia	£4 15

This practice of farmers combining to procure raw material from which to manufacture artificial manures is rapidly spreading we understand in agricultural districts elsewhere both in England and Scotland.

COFFEE PLANTING AND COFFEE FINANCING IN CEYLON.

We have received "Young Ceylon," a pamphlet reprinted from the *Madras Mail*, with the name of Mr. A. M. Anderson as the author. It is well when a man has much leisure that he should not cease to work. Our young friend has the pen of a ready and graphic writer, and he uses it frequently and copiously. His picture of the career of a youth coming to Ceylon to engage in coffee planting may be painted *couleur de rose* and not correctly in all its details, but still it may be interesting to our readers, so we quote as follows :—

What are the prospects of such young men, the

reader may enquire? They are good, indeed one might say brilliant, and, in all human probability, if blessed with good health, they will have attained independence by the time they reach middle age. On his arrival in Ceylon, the youth takes up his abode with an acquaintance of some years' residence in the island, with whom he learns the rudiments of his trade, including the Tamil language, in order to be able to converse with his coolies. In some cases he is at once installed in the post of Assistant Superintendent, for which he gets his londging and board, or, if he prefers it, £8-6-8 per month. While learning the arts of holing, lining, planting, handling, &c., the beginner keeps a sharp look-out after the sales of forest-land, which takes place at the Government Agent's Office in Kandy at frequent intervals. He has made up his mind to settle in one of the new districts, say Dimbula, Dikoya, or the Maskeliya Valley; the identical quarter he has chosen has been applied for, surveyed, marked out, and the auction is advertised in the *Government Gazette.* Our planter rides into Kandy on the appointed day to attend the sale, when there is a brisk competition ending by Lot 4,863, bounded on the north by Lot &c., and measuring 410*a.* 3*r.* 2*p.*, being knocked down to him at £4 10s. an acre. The price varies according to the run of popular taste for the moment, land going in some districts for the upset price of £1 an acre, while a block, perhaps inferior to it in coffee-bearing qualities, fetched £5, because it happens to lie in a locality where one or two lately opened estates have enriched their owners. However, such considerations are very far from troubling our friend, who makes a night of it in the Queen's Hotel along with the other purchasers, and rides home to his bungalow next morning with a bad headache, but the happy owner of a "wattie" in embryo. It is only a speck in the ocean of forest, but in anticipation it has already endowed its owner with the wealth of the De Soyzas, the princess of Sinhalese coffee planters. Life would be a poor affair without its day-dreams, and the planter is but one of the many who start on their career, with a belief in their certainty of success which greatly aids them in reaching the goal. It would be better for a man to dig for diamonds in South Africa, or plant cotton in the Fiji Islands, than to commence coffee planting, dispirited and mistrustful of himself. The first sharp attack of dysentery, or liver, will carry a man off as surely as the buoyant heart of the other will enable him to bear hunger, wet, and isolation without repining, as well as to resist the insidious attacks of disease.

Having secured his block of land, the next thing

the planter must do is to engage a Sinhalese contractor, who undertakes the felling and clearing of say 100 acres as a beginning. When this has been done, and a good "burn" has disposed of the dead leaves and branches, the real work commences. If the land is not too far removed from a neighbouring estate, the new man can chum with its superintendent and ride to and from his own place. Generally, however there is no help for it, but to rough it in a hut made of leaves of the talipot palm. In a new district where Government has not had time to trace roads, or build bridges, he may pass weeks without seeing a white face. The following extract from the letter of a Dikoya planter, under date the 27th ultimo, will serve to illustrate the difficulties attaching to his new position :—

"I had a very narrow escape from being drowned "last week, but I had the pleasure of saving a man's "life (G. S. whom you must remember on D. estate). "Four of us were crossing a large and deep river in "the Maskeliya, swimming with all our clothes on. "I got over first, then B.; but S. stuck half way, "and was drowning. I and B. jumped in and made "for him. He had got entangled, and we could not "get him loose for a long time: B. then gave in, "and I was left alone. S. was by this time nearly "insensible. I was quite exhausted when a Sinhalese "man came to my help, and then I let go and drifted "down. I fortunately struck against a dead stump "and caught hold of it, just as the native and S.'s "insensible body were sweeping past me. I caught "hold of them and held them till we were all landed "ashore. S. was a long time before he came round. "It gave us all an awful fright."

The Maskeliya, where this occurred, is the most recently opened district in the island, and forms part of an immense tract of forest, lying under the shadow of the sacred mountain, and hence named the Wilderness of the Peak. Except once a year, when pilgrims from the Sabaragamuwa country wend their way through it by devious and uncertain paths up to the "holy footprint," these vast solitudes are never trodden by man. The crack of the rifle has not as yet driven the elephant from his lair, nor startled the cheetah from his den in this awful wilderness. The Ceylon Government is not remarkable for its promptitude in giving roads to fresh districts. This seems rather like a breach of good faith on its part: for when land is put up for sale, it is understood that Government will lose no time in giving it a grant-in-aid road—that is to say a road, of which half the expense is borne by Government, and the other moiety by the planters. Through this tardiness many a

noble fellow succumbs or goes home invalided from being deprived of timely medical aid and nourishing supplies. That the fault is not Sir Hercules Robinson's will be borne witness to by every up-country resident; rather it is owing to the circumstances that the trail of the serpent has reached "India's utmost isle." The Parent Circumlocution Office sends out its offspring, who never completely get clean of their leading strings, or forget their early training. Sir Hercules has been emphatically the planters' friend, and for the extension of the railway from Peradeniya to Nawalapitiya alone, he deserves a statue erected on the highest mountain in the island.

We left the new landowner shivering in his talipot hut, his servant having just stated that the wood is too damp to admit of a fire being kindled to make early coffee, adding *sotto voce* that there was no milk, that the sugar was all melted, and the bread cooly not arrived. "Heaven's own consoler," tobacco, alone remains; so, lighting his pipe, the hungry youth proceeds to *line* his 100 acres, and having marked with pegs where the young plants ought to go, the coolies dig the holes. All this is not very difficult work, and when the necessary plants have been put in, there is little or nothing to do on the plantation until next year's clearing, and planting a fresh 100 acres. To give some idea of how capital may be expended, the following may be relied on as a fair estimate:—

Cost of Land 350 at £4 £1,400

FIRST YEAR.

Nursery	£15		
Felling, clearing 100 acres...	225		
Holing and planting ...	130		
Weeding	100		
Lines for coolies	50		
Roads and bridges	50		
Tools	15		
Miscellaneous	20	——	
Total, first year......		605	

SECOND YEAR.

Nurseries	£5		
Holing and planting ...	10		
Weeding	100		
Roads and bridges	10		
Tools	5		
Sundries	10	——	
Total, second year......		140	
		745	
Felling, clearing, planting, &c., another 100 acres as before ...		605	£1,350
Total expenditure...			£2,750

To those who have further capital, the rest is plain sailing. They have only to fell the remaining 150 acres, and in the meantime erect a bungalow, store, and pulping-house, as also to perfect the roads, and when all is in full bearing they are the lucky owners of an estate worth from £12,000 to £14,000, giving an income of £3,000 a year at least.

But such as have no more capital at their disposal must set about financing. There is plenty of money always seeking investment, and the planter can borrow on primary mortgage of his estate, at nine per cent per annum. His property is now worth—

100 acres planted—2 years old, at £24	...	£2,400
100 do do —1 year	...	800
150 do forest now worth £6	...	900
	Total...	£4,100

on this he can raise £3,000 which will pay for the buildings and opening the remaining land. One or two crops will pay off the debt, and then the proprietor is in as good a position as his brother capitalists. In the preceding estimate no charge has been made for superintendence or interest of money. In the case of a middle-aged man—or a retired Indian officer, who has a family, and objects to roughing it in the jungle, he would probably wish to purchase a plantation in full bearing. His views will be met without difficulty. One enterprising agent in Kandy advertises :—

"Coffee estates for sale in all districts, ages, and conditions, varying in size from 40 to 1,500 acres—and in price from £200 to £24,000. N.B., 56 estates now on the register—35 have been sold."

Supposing an estate of 350 acres is selected and the price fixed at £10,000 (there being 50 acres in forest): the purchaser pays down all the money at his disposal, say £3,000, and leaves the balance on a primary mortgage at 9 per cent. There still remains the difficulty of finding money to work the estate, to gather the crop, and despatch it, as well for his household expenses. Here the local Exchange Bank steps in and advances the needful at 8 per cent on what is styled a *Cash Credit.* By their Charters the banks are prohibited from advancing money as security on land or *block advances,* which brought the old Bank of Ceylon to ruin, but no such restriction applies to lending on *crops.*

Here it may be remarked that Ceylon is rather ahead of India in the matter of banking, as from its insular position it has been able to copy the Scotch system. Every little town and village has got its branch bank, which keeps current accounts, and ne-

gotiates drafts on Colombo, but priucipally cashes notes, which are of all denominations from R100 to R5, and are an immense convenience. It must not be imagined, however, that the *cash credits* above alluded to bear the faintest resemblance, except in name, to Scotch ones. In that country—when a person requires funds he applies to the Bank, which grants him the amount on the security of a bond, executed by him jointly with two or more individuals of respectability and substance. Beyond a fair rate of interest for its money, the bank derives no advantage from the bond, and the parties who become joint surety obtain actually no benefit at all, having given their names out of pure friendship. The Ceylon cash credit is quite another affair, and shows considerable ingenuity in its construction. The coming crop having been estimated by a competent judge, the amount of advance is fixed considerably within its probable value, and a bond is signed by the planter and his Colombo agents, by which the former undertakes to consign all the produce to the latter to be cured and shipped. The agents in their turn engage to hypothecate to the bank the bills of lading for the coffee when shipped, drawing against the same on their London correspondents at the rate of exchange of the day. The bank thus employs its deposits without risk, and does a profitable exchange business on London; the Colombo agents make sure of their commission for curing and shipping; and the planter gets his money at 8 per cent. Judging from the immense improvement visible of late years in Colombo, where the dingy hovels in which the local millionaires amassed their fortunes have given place to palatial edifices, all plate glass and stucco, (!) it cannot be urged that the arrangement is unprofitable to the agents at any rate. To the banker considerable discretion is left, as he can fix the rate of exchange at pleasure; but taking the bank, drawing rate at Calcutta for six months' sight bills on London, as the central pivot round which all his operations must revolve, it will be found that the planter is fairly dealt with, and does not pay more than 2 or 3 per cent above that rate.

SHEWING HOW A COFFEE PLANTATION CANNOT BE PROPERLY OPENED UNDER £25 AN ACRE.

(To the Editor of the *Ceylon Observer.*)

Dear Sir,—It is not often that matters connected with coffee planting in Ceylon are noticed by our

friends in India; it was, therefore, with a certain amount of pleasure that I perused the few extracts you were pleased to give us in your issue of the 2nd from a pamphlet entitled "Young Ceylon."

After indulging in a few pleasant little anecdotes, our worthy author proceeds to explain the process of opening up land and supplement his observations by a row of figures, which he is pleased to term an estimate of the cost of the various items of expenditure, and adds, moreover, that we may consider it reliable.

Now, although Mr. Anderson may be, as you suggest, a very clever young man, he has most certainly stultified himself in the matter of this so-called estimate, and his figures are unfortunately not quite so reliable as his vocation would lead us to expect.

Not being gifted with the same fertile imagination as our festive banker, we must be content to follow the ideas he is pleased to give us, and imagine, if we can, the "happy youth"—for so he designates the young planter—commencing operations by lining his 100 acres clearing, premising, however, that the talipot hut he lives in is erected *for nothing*, and that whatever personal supervision he may be disposed to give to the various works is gratuitous, and forms no part whatever of the estate expenditure. The process of lining he describes as being simple, *so simple in fact as to be costless* (vide estimate), and, although he indicates that pegs are necessary, he believes most firmly that they are cut and collected by some exceptionally accommodating Hindu for nothing. Now-a-days we are not so fortunate, and are generally content to pay from 5s. to 6s. per acre for the proper completion of this work. Our attention is next invited to the "Holing and Planting" which, if one may judge from the estimate, are done both together, and without the intermediate and evidently superfluous operation of refilling. But to return to the holing, which we will assume for the sake of argument he has allowed £100 for. Now has Mr. Anderson or any other Mr. Anderson ever known a clearing to be *properly holed* at a cost of £1 per acre? I am aware that some planters cut as many as 50 *nominally* eighteen inch holes, but in *reality* what are they? Let the intending investor satisfy himself by a visit to the Eldorado of Ceylon. Holing to be *properly* done represents £1 10s per acre *at least*, and careful refilling may be fairly estimated at 10s per acre. With regard to planting we are not deigned much information, but the purchase of plants, rather a formidable item in an out-of-the-way district, is a matter too insignificant to receive his attention. The other

items in his first year's expenditure are ordinarily correct. We now come to the second year, which as regards omissions, is a fitting continuation of the first. Topping, staking, suckering, draining, &c., are in the opinion of our economical banker works, if not altogether unnecessary, at least too insignificant to render an estimate of their cost necessary; the wretched talipot hut still exists, and the lines erected in the first year are as waterproof as ever. So much then for our "reliable" estimate ! ! !

It is the incessant croak of these so-termed ready writers, who do Ceylon so much harm. The not improbable result of Mr. Anderson's effusion will be a flood of small capitalists into the colony, who with £1,000 in one pocket and "Young Ceylon" in the other will rush headlong into the first speculation which offers, and of course come to grief. If Mr. Anderson would content himself with his counter, and leave the framing of estimates to men more competent to the task, he would receive the thanks of those who have a soul above "Cash Credits," and who know far better than *he* possibly can the advantages Ceylon offers to the capitalist.

Practical men know but too well the cost of opening up land as it *should* be opened, and although possibly the modern planter is backed up in his tight-laced notions of economy by men of such standing as Mr. Brown, still it requires but a glance at the estates opened up by these £8 and £10 per acre men to convince the most sceptical that economy can be carried too far. You have difficulty in ascertaining the direction of the lines, the holing is not worthy of the name, the roads, if any exist, are dangerous to walk upon, and the term *slovenly* is applicable on all sides. Land, to be thoroughly opened up, drained, roaded, with permanent buildings, &c., represents £25 per acre at the end of the third year. If done at a lower figure, you may be pretty certain that something has been neglected and the property is not what it should be

Mr. Brown estimates nothing for "General Transport," "Miscellaneous," "Draining," and "Contingent Expenditure." Lining he thinks can be done for 2s per acre, while the cutting of pegs is supposed to cost half as much again; surely under this latter head Mr. Brown must have included the cost of lime for whitewashing them !

It would be well to ventilate this matter as much as possible, and ascertain from men of experience in the new districts the actual cost of opening up land *properly*.

The estimate Mr. Sabonadière has been pleased to

furnish us with is nearer the mark than many supposed. It is, however, somewhat difficult to follow his arguments in favour of building a £300 bungalow for the superintendent the first year, assuming (as he himself assumes) that the estate is managed and brought into bearing by a neighbouring planter. What right, however, have we poor d——ls to be nice? It is not every day we have the experience of so distinguished a manager to guide us, and although possibly we do not share with him the amusement of dabbling in mud and mortar before it is necessary, still it is satisfactory to know that there is no occasion to do so.—Yours faithfully,

SCEPTIC.

[Barring the caustic tone of this writer's references to Messrs. Sabonadière and Brown, we consider his letter a valuable and sober statement of the truth. With holes as large as they ought to be, and the valuable potash, charcoal, and surface vegetable matter drawn into them thoroughly, £25 an acre, or £2,500 expended on 100 acres at the end of the third year, is not too large a sum to calculate on. Expenditure restricted in the preliminary operations of planting and holing must mean larger expenditure or smaller returns in after years. Coffee land ought, if possible, to be trenched and permeated by sunk drains. As such operations are (financially) impossible, the greater the necessity for large holes, and plenty of paths, roads, surface drains (deep), and water holes.—ED. C. O.]

THE "COFFEE PLANTERS' MANUAL" AND THE COST OF OPENING ESTATES.

The "Planters' Manual" with its various additions was just leaving the printer's hands when the letter of "Sceptic" appeared, criticizing the estimates framed by Messrs. Sabonadière and Brown of the cost of opening a coffee estate. We were unwilling to send the work forth without some explanation of the moderate estimates of the writer of the "Manual," in reply to his critic, and accordingly have been pleased to receive the following remarks which shew that experience is not wanting to substantiate the calculations made by Mr. Brown ;—

"My object throughout the work was to shew on how low a scale a coffee plantation *can* be opened by a man of small means *with great care and economy*; not to shew *how much can be spent in doing the same work.* This has been sufficiently illustrated before, and at the cost of many a proprietor. If I omitted

General Transport, I have been liberal in some matters that need not be entered upon till the estate be in bearing, such as *roads*. Of course an estate cannot be worked without roads, and he who has plenty of money will do well to open them early. But I am all along supposing a man who has *not* plenty, and who therefore will only do what is absolutely necessary at first, leaving complete and finished work to be done when the means to do it with come to hand. Now in this respect were I to be very exacting, I would for the first two years make £10 spent on roads do the work for which I have allowed £50. Besides, the item which I am charged with having omitted, *General Transport*, consists chiefly of bringing the superintendent's provisions and those of his coolies to the estate. As I have supposed the case of the estate until bearing being managed by a neighbouring superintendent, no allowance on that score was necessary, while as regards rice to the coolies, it is generally supplied at a rate that covers its transport, unless in very out-of-the-way districts. I adhere therefore to my figures, and I will tell you further that they are not framed upon new Dimbula experience with soft soil and small holes, nor on the plan of shirking work and stinting expenditure. My calculations are based upon proper work and 18 inch holes, and are the same as they were 20 years ago. About that time, the young estate I referred to was planted under my inspection by a very careful manager of an adjoining estate, and brought into bearing for £10 an acre. Of course it had the advantages of the old estate adjoining supplying lines, bungalow, tools, and other conveniences with which the new estate in the same connection had not to be taxed. The estate opened and brought into bearing for £8 an acre was not connected with any previous estate in the district. The books which I saw proved my figures correct. I do not say everybody can do this, nor will all seasons of soils admit of it. But I instance these to shew what can be done under favouring circumstances, while the average rate allowed by me is fifty per cent higher. In that estimate too I am borne out by such men as * and many others, all practical planters, who would not spend a penny unless absolutely necessary, nor stint a penny that was actually required. I do not, however, wish to be drawn into a discussion of estimates or anything else at present. I shall let every one say his say, and if there be anything of importance to answer

* Several of our most experienced planters are here mentioned.—Ed. C. O.

shall take them all up together at the end and reply. *Sceptic* rather takes a liberty in criticizing the work done by the £8 and £10 per acre men; seeing he does not know one of the estates to which I referred. They, however, would well repay inspection, but that must be invited by their proprietors, not by me. All I say is that in both the work was well and satisfactorily done: one has yielded handsomely paying crops for many years; the other (only 7 or 8 years old) has done so since its 3rd year, when it yielded 10 cwts. an acre."

COST OF OPENING COFFEE ESTATES.

(To the Editor of the *Ceylon Observer.*)

April 4th, 1872.

SIR,—Practical people will hold the same view which your correspondent "Sceptic" takes of the subject of the cost of bringing a coffee estate into bearing. I have no hesitation in denouncing as *selfish* and wrong in the extreme that advocacy which overwhelms young men, the possessors perhaps of a wretched one thousand pounds or upwards, with an insatiable vanity to become what is out here termed a *proprietor*, and thereby risk their "all" to such an extent that it might appropriately be called throwing it away.

I remain, yours very truly,

"OF PLUNGING BEWARE."

[While leaning ourselves rather to *Sceptic*'s estimate of the cost of opening a coffee estate properly, than to the lower ones advanced, and which are generally based upon work done under exceptionally favourable circumstances, yet we candidly confess that the number of instances in which such cheap, and yet we suppose good, work has been done in beginning to multiply. Here is the latest from a correspondent, who says:—"I have just extracted from the books of estates in Dimbula the cost of their opening:—

	£	s.	d.
No 1.—67 acres—Cost of felling	132	0	0
Lining and planting	58	14	7
Plants	25	0	0
Roads	7	14	3
Weeding	182	0	0
Superintendence	160	0	0
Amount expended in 2 years and 8 months	£565	8	10
No. 2.—86 acres planted July and August 1870			
Expended to June 1871	£568	4	2
100 acres felled in 1871, no burn included	150	0	0
Expended to April 1872 including superintendence	373	7	3
Over two years ...	£1,091	11	5"

COFFEE PLANTING IN NATAL.

Some time has elapsed now since we received from the author, Mr. W. H. Middleton, of Snaresbrook Estate, Natal, a copy of his "Manual of Coffee Planting," intended for the use of planters in that Colony. It is a pamphlet made up in the form of letters on the cultivation of coffee, and as the author tells us "professes to be only a relation of the practical experience and observations" of himself and a few friends who had given him information. The author accompanied the brochure with a private letter in which he was good enough to ask our advice with reference to a second edition, and especially on the value of a novel idea which had occurred to him as worthy of being recommended to Natal planters. The second edition has since been published, and a copy of the book has reached us which we will notice hereafter. Meantime, this second book having appeared, and the letter before us being dated 1866, there can be no breach of confidence in laying Mr. Middleton's theory before our readers. It is as follows:—"In Natal I find that the coffee tree bears most *abundantly and with certainty* for the first three or four years; but afterwards the crop is very uncertain both in quality (well-formed beans) and quantity, owing, I think, to a deficiency of good bearing wood. Perhaps this to a certain extent might be corrected by proper and careful pruning, but it is most difficult to obtain the skilled labour for this purpose either in number or efficiency. Now, would it not be better to carry out the following plan:—say, plant out the fields in rows 9 or 10 feet by 5 or 6 feet, and in four years plant again between these rows. At the end of the 7th year cut down the first trees planted, the second planted will then be in bearing. After one year of fallow, replant in the rows where the first planted trees were placed. By this means there would always be a succession of vigorous young bearing trees, which would require less labour (especially skilled) and return a better and more certain crop than if depending upon the old stock." Coffee planting in Natal must offer a great contrast to the same pursuit in Ceylon to permit of Mr. Middleton suggesting even a mode of cultivation so impracticable and expensive! It must indeed be a poor look-out where the coffee shrub begins to languish in its seventh year, an age when it is usually in its prime, and whatever may have been the cost and scarcity of skilled labour for pruning, the Natal planters cannot fail to find the process of replanting recommended by our author much more expensive and unsatisfactory. We handed the copy of the first edition of the Manual itself at the time

of its receipt to a practical planter, who favoured us with the following notice of its contents, which, with the other papers referred to, has been overlooked too long. Since the review was penned, the writer has himself drawn up at our request "The Manual for Coffee Planters," to the pages of which we may now refer our Natal friends for information respecting the *modus operandi* in Ceylon :—

A MANUAL OF COFFEE PLANTING; BY W. H. MIDDLETON, SNARESBROOK, NATAL.

Published by Adams & Co., Durban, Natal, 1866.

This little pamphlet contains in its fifty-two pages a good deal of information important to an incipient planter. In fact a little respecting almost every operation of the plantation. The felling of the forest it is true is not described, but perhaps they have no forest in Natal. The *land* should be of the kind says our author that will absorb and hold in suspension the most water. Some of the early settlers in our Ambagamuwa district would take exception to this doctrine, for their lands held the water so long and so tenaciously that it washed away all their rupees. Very probably however the land of Natal is chiefly sandy, and planters are glad when they hit on a piece that retains moisture, for we cannot suppose that they wish it to hold water in its liquidity.

An eastern aspect is also recommended. We would add that this is not always the most desirable in Ceylon, especially under 2,000 feet elevation, for when the soil is thin and porous, too strong a sun in the early morning is not desirable. At elevations of from 3,000 to 4,000 feet, an Eastern is generally a safe exposure.

The Java style of tree is thus described as from 5 to 6 feet high, which he thinks bears the greatest quantity. Our experience in Ceylon, both for bearing capability, facility of management, and early return, is in favour of a low tree, 3 to 4 feet, unless in very exposed places where they are sometimes cut down as low as 1½ foot.

The borer is described as a beetle which does very little damage. This cannot be the insect which has been committing such ravages in India, as it is described as more resembling a caterpillar with a very hard head. There are few insects destructive to the coffee plants in Natal, but our author instances one which he says leaves a brown shell on the leaf. This must surely be *the bug*.

Berries found perfect under the trees he thinks are the work of rats. If there are monkeys in Natal, they are more probably the depredators. But several

classes of animals pick the coffee so and leave the parchment in heaps in this country, and what is worst the rogues can never be apprehended.

Nursery plants cost £4 13s 8d per 1,000; formerl they cost £7 10·. This is a frightful price, and iy is quite time each estate in Natal had its own nurseryt for at this rate an estate of 200 acres would cost, about £1,000 for plants!

Holing.—40 to 60 per day of holes 3 feet in diameter by 18 inches deep would gladden the heart of a Ceylon planter. We are obliged to put up with much less; very probably the Natal soil is softer than ours.

Planting distance.—7, 8, and 10 feet are all very wide. But they grow cotton between, which must be a doubtful benefit.

Jamaica picking is instanced as costing on an average 1s per bushel. We cousider 6d high and certainly could not afford 1s. At *Rio* pickers have to go and bring in their day's work in a bag probably 1 to 2 bushels. *Natal picking* is cheap—chiefly done by women, girls and boys at 6d per day. But we cannot exactly reconcile this low rate of wages with the intimation that kafirs who are extolled as models of tractability, are so uncertain that the planters are obliged to import Indian labour which costs about 28s per month. Perhaps this is a work, however, for which the kafir women and children have a predilection, and therefore turn out to it—only if they do not, and if the 28s labour has to be had recourse to, the above figure will not answer.

Calculations of an estate coming into bearing with maiden crop of 2 cwts. the third year, and afterwards giving 7 cwts. per acre annually for a new and comparatively untried district like Natal, out of the tropics too, are evidently *speculative* as the author nowhere says that such crops *have been* realized. But if he is sure that they can be borne out, it shews coffee planting in Natal to be a very paying investment. Strange however as it may seem in the face of this statement, several Ceylon planters who have gone there to settle have not found their expectations realized. On the whole while the pamphlet contains nothing that is new, it contains a good deal that is true and will prove a useful handbook to a beginner.

THE PREPARATION OF COFFEE.

The preparation of coffee is at present so interesting a subject to the trade that we reproduce below some remarks published by Baron Liebig a few years ago on the subject;—

"The chief operation is the roasting. On this depends the good quality of the coffee. In reality the berries should only be roasted until they have lost their horny condition, so that they may be ground, or, as it is done in the East, pounded to a fine powder.

"Coffee contains a crystalline substance named caffeine or theine, because it is also a component part of tea. This matter is volatile, and every care must be taken to retain it in the coffee. For this purpose the berries should be roasted till they are of a pale brown colour; in those which are too dark, there is no caffeine; if they are black, the essential parts of the berries are entirely destroyed, and the beverage prepared from these does not deserve the name of coffee.

"The berries of coffee once roasted lose every hour somewhat of their aroma, in consequence of the influence of the oxygen of the air, which, owing to the porosity of the roasted berries can easily penetrate. This pernicious change may best be avoided by strewing over the berries when the roasting is completed, and while the vessel in which it has been done is still hot, some powdered white or brown sugar (half-an-ounce to one pound of coffee is sufficient). The sugar melts immediately, and by well shaking or turning the roaster quickly, it spreads over all the berries, and gives each one a fine glaze, impervious to the atmosphere. They have then a shining appearance, as though covered with a varnish, and they in consequence lose their smell entirely, which, however, returns in a high degree as soon as they are ground. After this operation, they are to be shaken out rapidly from the roaster and spread on a cold plate of iron, so that they may cool as soon as possible. If the hot berries are allowed to remain heaped together, they begin to sweat, and when the quantity is large, the heating process, by the influence of air, increases to such a degree that at last they take fire spontaneously. The roasted and glazed berries should be kept in a dry place, because the covering of sugar attracts moisture.

"If the raw berries are boiled in water, from 23 to 24 per cent of soluble matter is extacted. On being roasted till they assume a pale chestnut colour, they lose from 15 to 16 per cent, and the extract obtained from these by means of boiling water is 20 to 21 per cent of the weight of the unroasted berries. The loss in weight of the extract is much larger when the roasting process is carried on till the colour of the berries is dark brown or black. At the same time that the berries lose in weight by roasting, they gain in volume by swelling; 100 volumes of green berries

give, after roasting, a volume of 150 to 160; or, two pint measures of unroasted berries give three pints when roasted.

"The usual methods of preparing coffee are: 1st, by filtration; 2nd, by infusion; 3rd, by boiling.

"Filtration gives often, but not always, a cup of coffee. When the pouring the boiling water over the ground coffee is done slowly, the drops in passing come in contact with too much air, whose oxygen works a change in the aromatic particles, and often destroys them entirely. The extraction, moreover, is incomplete. Instead of 20 to 21 per cent, the water dissolves only 11 to 15 per cent, and 7 to 10 per cent is lost.

"Infusion is accomplished by making the water boil, and then putting in the ground coffee, the vessel being immediately taken off the fire, and allowed to stand quietly for about ten minutes. The coffee is ready for use when the powder swimming on the surface falls to the bottom on slightly stirring it. This method gives a very aromatic coffee, but one containing little extract.

"Boiling, as is the custom in the East, yields excellent coffee. The powder is put on the fire in cold water, which is allowed merely to boil up a few seconds. The fine particles of coffee are drunk with the beverage. If boiled long, the aromatic parts are volatilized, and the coffee is then rich in extract, but poor in aroma.

"As the best method, I adopt the following, which is a union of the 2nd and 3rd:—The usual quantities both of coffee and water are to be retained; a tin measure containing half-an-ounce of green berries, when filled with roasted ones, is generally sufficient for two small cups of coffee of moderate strength, or one, so-called large breakfast cup (one pound of green berries, equal to 16 ounces, yielding after roasting 24 tin measures [of $\frac{1}{2}$-ounce] for 48 small cups of coffee). With three-fourths of the coffee to be employed after being ground, the water is made to boil 10 or 15 minutes. The one quarter of the coffee which has been kept back is then flung in, and the vessel immediately withdrawn from the fire, covered over, and allowed to stand for 5 or 6 minutes. In order that the powder on the surface may fall to the bottom, it is stirred round; the deposit takes place, and the coffee poured off is ready for use. In order to separate the dregs more completely, the coffee may be passed through a clear cloth, but generally this is not necessary, and often prejudicial to the pure flavour of the beverage. The first boiling gives the strength, the second addition to the flavour. The water does not dissolve of

the aromatic substance more than the fourth part contained in the roasted coffee.

"The beverage, when ready, ought to be of a brown black colour; untransparent it always is, somewhat like chocolate thinned with water; and this want of clearness in coffee so prepared does not come from the fine grounds, but from a peculiar fat resembling butter, about 12 per cent of which the berries contain, and which, if over roasted, is partly destroyed. In the other methods of making coffee, more than half the valuable part of the berries remains in the 'grounds' and is lost.

"To judge as favourably of my coffee as I do myself, its taste is not compared with that of the ordinary beverage, but rather the good effects might be taken into consideration which my coffee has on the organism. Many persons, too, who connect the idea of strength or concentration with a dark or black colour, fancy my coffee to be thin and weak, but these were at once inclined more favourably, directly I gave it a dark colour by means of burnt sugar, or by adding some substitute. The real flavour of coffee is so little known to most persons, that many who drank my coffee for the first time doubted of its goodness, because it tasted of the berries. A coffee, however, which has not the flavour of the berry, is no coffee but an artificial beverage, for which many other things may be substituted at pleasure. Hence it comes that if to the decoction made from roasted chicory, carrots, or beetroot, the slightest quantity of coffee be added, few persons detect the difference. This accounts for the great diffusion of each such substitute. A dark mixture, with an empyreumatical taste, most people fancy to be coffee. For tea there are no substitutes, as everybody knows what real tea is like."

COFFEE PRICES SINCE 1845.

These are given in the tables which the *Economist* prints with its Commercial Review for 1871. For the sake of uniformity, Jamaica fine ordinary to fine is taken as the standard, as, in 1845, Ceylon coffee instead of having established its character as the best in the market was ranked amongst the worst. The general result for the period embraced is that prices have risen from an average of 45s to 54s per cwt. in the years 1845-50, to 67s on 1st January 1872, an advance of 18s over the average of the two extremes of 1845-50, of 23s over the lowest price then, and of 13s over the highest. The fluctuations in the in-

terval have been considerable, as the detailed figures will shew :—

		per cwt.				per cwt.	
		s	s			s	s
1845-50—Av. 6 yrs.		44@54		1870—1	January	55@76	
1851—1	January	53	58	1871—1	January	50	73
1853—1	July	50	,,	1	February	58	75
1857—1	July	68	80	1	March	,,	,,
1858—1	January	50	62	1	April	54	,,
1861—1	January	63	70	1	May	,,	,,
1862—1	January	70	80	1	June	,,	,,
1863—1	January	72	85	1	July	55	,,
1864—1	January	70	79	1	August	,,	,,
1865—1	January	74	84	1	September	58	,,
1866—1	January	70	85	1	October	61	,,
1867—1	January	65	81	1	November	63	,,
1868—1	January	58	80	1	December	66	,,
1869—1	January	52	72	1872—1	January	76	,,

We quote also the note :—

" *Wholesale Prices of Commodities.*— 1845-50, 1851-70, and 1871.—We have followed in this table the arrangement and method adopted by Mr. Tooke and Mr. Newmarch in the History of Prices (V and VI), and continued by the latter in the *Statistical Journal* for 1859-60 and 1861. The average prices of the six years 1845-50 were first given by the same gentleman in the *Statistical Journal* for March, 1860, and were then described as compiled from the weekly prices given in the *Economist.* All the other prices in (*A*) are obtained from the same source. The table, therefore, possesses at least the advantage of being derived from first to last from the same authority."

The highest point, our readers will observe, was attained on 1st January 1865, when prices ranged from 74s to 84s. The lowest prices subsequently were 52s to 72s on 1st January 1869, and 50s to 73s on 1st January 1871. While the higher rate remain stationary since, it will be seen that the average of 61s rose to 72s in the twelve months of 1871, and we suspect that in twelve months more the figure is likely to be 80s.

Then comes table C, thus explained :—

" *Wholesale Prices—Proportionate Results.*—The construction of this table is explained in the note which is given at the foot of it. It is formed upon the example first given by Mr. Newmarch in the *Statistical Journal* of 1859, and since followed by Mr. Jevons in his very able pamphlet on the Effects of the New Gold."

The note states :—

" The construction is as follows :—The basis of 100 represents the average prices of the six years 1845-50,

and all the subsequent figures are calculated from that Datum line. Thus as regards coffee (Col. 1), the price of 1st July, 1857, was equal to 151, or 51 per cent above the average prices of 1845-50. In order to ascertain the *percentage* rise or fall between one date and another—as for example *Coffee*—comparing 1st July, 1857, when the figure was 151, with 1st January, 1866, when the figure was 179 or a difference of 28, the rise per cent has to be measured with the quantity 151, and gives of course a result of 19 per cent as the real advance. In the course of so long a period of years as 1845-71, some variations have inevitably arisen in the mode of quoting prices in the usual Prices Current. In all such cases the nearest approach possible has been made to an *uniform* quotation throughout the Table. In *Raw Cotton* especially there have been considerable change of *qualities* introduced by the large use of Indian, &c., kinds. In *Tea* and *Sugar* also changes have occurred in the kinds most usually quoted."

In this case we include the columns for sugar and tea as well as for coffee:—

Dates.	1 Coffee.	2-3 Sugar.	6 Tea.
1845-50, Average 6 years.	100	100	100
1851—1 Jan.	114	94	129
1853—1 July	110	70	129
1857—1 ,,	151	123	162
1858—1 Jan.	114	83	140
1861—1 Jan.	131	77	151
1862—1 ,,	153	70	126
1863—1 ,,	160	65	126
1864—1 ,,	152	85	124
1865—1 Jan.	161	65	108
1866—1 ,,	179	72	141
1867—1 ,,	149	66	108
1868—1 ,,	141	73	104
1869—1 Jan.	127	72	105
1870—1 ,,	134	83	102
1871—1 ,,	125	83	100
,, —1 July	133	78	100
1872—1 Jan.	145	83	100

According to this table coffee reached its highest point on 1st January, 1866, when an advance of 79

per cent was established over the average of 1845-50, the percentage of rise over 1st January, 1865, being 11, while the fall in 1867 as compared with 1866 was no less than 17 per cent. On 1st January, 1871, prices had gone down 30 per cent from the level of 1866, and even on 1st January, 1872, they were 19 per cent below the highest point, but 45 per cent above the low level of 1845-50. While there has been such a rise in coffee prices, those of tea are now exactly what they were a quarter of a century ago. This comparative cheapness accounts largely no doubt for the increase in the consumption of tea in Britain while coffee went back.

ANALYSIS OF SOILS.

We copy from the second edition of Mr. Middleton's "Coffee Tree in Natal" the following:—

In the meanwhile, I have thought it well to introduce here a few simple directions for obtaining an approximate analysis of the chief physical characteristics of soils, taken from Johnstone's Lectures on Agricultural Chemistry and Analysis of Soils. The appliances required are a fine pair of scales, a thin metal saucer (it should be platinum) for burning the soil (in a cleaned and smooth lead ladle would answer the purpose), a glass tube graduated into inches and 10ths, and a bottle of muriatic acid.

To dry the soil: take 100 grains of soil at atmospheric dryness, spread it on white paper, and put it in an oven or on a hot plate at such a heat that it will only slightly tinge the paper (it should not exceed 250 to 300 degrees); then re-weigh; the difference is moisture.

To ascertain the quantity of organic matter: place it in your saucer and bring it to a dull, red heat. It will first burn black at the edges and so throughout. When this is completed, it will become pale brick red; re-weigh, and the loss will be organic matter.

To estimate the quantity of lime: put this burnt soil into a pint of pure water, and add half a wine-glassful of muriatic acid; after being stirred two or three times let it settle, and pour off the water; add fresh water to wash away the acid, and again rendering it to a dull red heat, re-weigh; the loss will be somewhat less than the actual quantity of lime.

To ascertain the physical characteristics: dry 1,000 grains as before described, put it into a glass tube and shake it or knock it on the table till it settles to its lowest level, mark it and shake it loose again, and add water till it will absorb no more; note the

difference; this will give its porosity or power of absorption. Now add water till the tube is nearly full, and shake the whole well up—the soil should occupy about one-third of the tube, and place it in a perpendicular position to settle. It will be then observed that it has arranged itself in the order of the specific gravity of each component part of the soil: the coarsest sand will be found at the bottom, and the finest impalpable powder at the top—the latter is its most valuable constituent.

Care must be observed in selecting the soils for these experiments—several samples of the same sort at distances from each other must be taken an inch or two under the actual surface; these should be well mixed together, and the quantity to be weighed taken from it.

I think it would scarcely be within the limits of this small treatise to go further into the matter of density, proportions of clay and sand, and the finer analysis; the formulæ will be found in Johnstone's Analysis of Soils and his Lectures on Agricultural Chemistry, to which I would refer my readers who are interested on any further investigations.

ROUGH METHOD OF ESTIMATING BY QUANTITATIVE ANALYSIS THE POTASH AND PHOSPHORIC ACID CONTAINED IN SOILS.

This paper was drawn up by Dr. Koch, of the Colonial Medical Department, at our request. In forwarding it he wrote:—

"My own idea is that this kind of testing cannot be done successfully, but by those who have studied the subject carefully.

"The specimen of soil for examination must be well pulverized and thoroughly dried in the sun. Weigh 100 grains and digest it for an hour or two in pure hydrochloric acid. The mixture is then to be gently boiled for about half an hour, and filtered through blotting paper; wash the residue with boiling distilled water. The filtrate and washings will now contain the alkalies and alkaline earths in the form of chlorides. Add a few drops of nitric acid to the clear solution, and gently warm the mixture. After cooling add an excess of solution of ammonia and sesquicarbonate of ammonia. This will cause the separation of all the iron, aluminum, and a portion of the lime and magnesia in the soil. Filter again and add to the clear liquid a solution of oxalate of ammonia. This will remove all the lime in the form of a white

precipitate of oxalate of ammonia. Filter, and add to filtrate an excess of solution of ammonia and arseniate of ammonia: this will cause the separation of magnesia present. Filter—the clear liquid will now contain the alkalies potash and soda. Heat it to dryness and dissolve the residue in a few drops of water, and add an excess of a solution of bichloride of platinum, then heat again to dryness, dissolve the residue in distilled water and filter. What remains in the filter is a double salt of potassium and platinum, dry and weigh, 100 parts is equal 19·26 of potash.

Take 100 grains of the dried soil, digest and boil in hydrochloric acid and add ammonia as in last experiment, collect the precipitate on a filter and wash it with boiling distilled water. Now dissolve the precipitate in dilute nitric acid. Add to it an excess of a solution of molybdate of ammonia, and apply a gentle heat to the mixture for 24 hours, the precipitate will contain all the phosphoric acid in the specimen.

EDWIN L. KOCH.

[We fear that the vast majority of the planters will be unable to follow the processes, but under the belief that a few here and there may find the recipe useful for themselves and their neighbours we give it.]

ADDITIONS IN THE SECOND EDITION.

☞ So far, we have reprinted the Manual and the appended papers as they appeared in the first edition of the book: we now add several other papers and communications bearing on a coffee planter's work, including summaries of discussions which have appeared in the columns of the *Ceylon Observer* on Manuring and Artificial Manures; Analyses of Soils; the cause and effect of Grub at the roots of the Coffee tree; Estimating Crops, &c. &c.—COMPILERS.

THE

COFFEE PLANTER'S MANUAL, SECOND EDITION.

DIRECTIONS FOR TAKING SAMPLES OF SOIL FOR ANALYSIS.

(*From Hughes' Report on "Ceylon Coffee Soils and Manures."*)

Having selected a piece of ground where the soil appears uniform in composition, take a cubic foot of the surface soil, or a large spadeful to the depth of one foot, from at least six places from the selected spot; mix the six portions thoroughly together in some central place, and send about 5 lbs. in a clean tin or wooden box. Each sample of soil sheuld be numbered, and the box marked with the name of the estate in black letters. Samples should not be taken from recently manured ground, and where manure holes have been made in past years, great care must be taken to avoid such when drawing samples.

For comparison it will be very useful to send a sample of good coffee soil, which should be specially marked. Information is requested in reply to the following questions respecting the land from which the samples are taken:—

1. The elevation and average rainfall.
2. Situation as regards sun, wind, &c.
3. General appearance and character of the sub-soil.
4. What kind of drainage.
5. Number of years in coffee.
6. What manure, and what quantity has been used per acre; also the effect of same?
7. Is there any natural peculiarity about the soil?
8. What are the average crop returns per acre?
9. What is the natural tendency of the soil as regards production of wood, leaf and crop?
10. State any general particulars respecting the past history and present condition of the soil, that may be considered desirable.

ANALYSES OF SOILS.

A careful analysis of a soil requires much more time than is generally supposed. It frequently happens that certain operations have to be performed two or three times before the analytical results can be considered to satisfactorily represent the correct composition.

The determinations of phosporic acid, nitrogen and potash require special care and delicacy of manipulation.

CROP ESTIMATES.

(*To the Editors "Ceylon Observer."*)

Dear Sirs,—In former times managers used to estimate their crops very accurately. Agents and owners relied on their estimates with confidence, and would have been surprised and disappointed if a deficiency of crop of so much as ten per cent had occurred. Such shortfalls as have become frequent of late were quite unknown. Estimates were generally revised and settled about July, when the fruit showed up,—but such a thing as a deficiency of 30 or 40 per cent being first discovered after crop had commenced was never heard of till quite recent times. Such disappointments are now, however, unfortunately, but too common. Is it that the present generation of planters are less able, or more careless than their predecessors? Certainly not! Even those old planters who, in former days, used to be so accurate, have, since 1870, been as far out in their reckonings as their younger neighbours. I have in mind a recent instance of a crop, originally estimated by a very careful manager, of 12 years' experience, subsequently confirmed by an old stager, who knew the estate intimately, and again by a visitor who prides himself that he is never deceived, yet this crop fell short by 50 per cent of the estimates so made and confirmed, and the deficiency was not suspected till the gathering began!

The simple fact is that of late years, leaf disease and adverse seasons have so impaired the strength of the trees that they cannot now mature their fruit as they used to do. Original estimates, I doubt not, are as accurate now as they formerly were, but there is now a continuous shedding of the young berries, which is often quite unperceived and unsuspected until revealed by the early gatherings. The berries in the cluster become reduced in number as they increase in size. As the first fruit swells, the failure of that which should follow eludes observation, until gathering begins, when the astonished manager discovers that there is little or nothing left behind.

Such serious disappointments as have lately occurred but too frequently are extremely embarrassing to agents and financiers, especially when they are revealed at so late a period of the year; and they beget distrust as well as confusion. Hence the paramount importance of adopting such means as we possess for preventing them: and this may assuredly be done by ascertaining the actual fall of the immature fruit.

The method I adopt, and confidently recommend, is to select, in each field, two or three branches, on different trees, fairly representing the average bearing branches of the field; and to count the berries in each of these selected branches from time to time, beginning a month after the blossom and continuing throughout the season to recount them every fortnight. Each selected branch should be marked and numbered, and a careful record should be kept of the result, which will indicate infallibly the loss by premature fall of fruit, and enable the manager to foresee the proportion of the whole which he is likely to harvest. The counting of the berries should be continued till near the end of crop, and should be done by the manager himself, or a very trustworthy assistant, who, as crop begins to ripen, should always precede the pickers and gather from the selected branches all the ripe berries, taking due account of the number gathered. Each successive counting will tell its tale, and any serious failure of the fruit must become evident quite early in the season.

I think it probable that the method of counting the berries on selected branches in each field might serve as a very useful means of forming original estimates of crop, but I have not tried it with that object. The ordinary method of estimating has been proved by long experience to be sufficiently accurate unless disturbed by an abnormal fall of fruit. I have therefore confined my attention to the method for this latter purpose only, and have found it effectual. How, indeed, could it be otherwise?—Yours obediently, OLD PLANTER, March 1880.

HOW TO BUY ARTIFICIAL MANURES: VOELCKER'S RULES.

DEAR SIRS,—It may perhaps be useful to proprietors and superintendents to know the following rules (given by Professor Voelcker) in order to guide them in the purchase of artificial manures:

1, Raw or green bones, or bone dust, should be purchased as "pure" raw bones guaranteed to contain not less than 45 per cent of tribasic phosphate of lime, and to yield not less than 4 per cent of ammonia.

2. Boiled bones should be purchased as "pure" boiled bones guaranteed to contain not less than 48 per cent of tribasic phosphate of lime, and to yield not less than 1¾ per cent of ammonia.

3. Dissolved bones are made of various qualities, and are sold at various prices per ton; therefore

he quality should be guaranteed under the heads of soluble phosphate of lime, and nitrogen or its equivalent in ammonia.

The purchaser should also stipulated for an allowance for each unit per cent; which the dissolved bones should be found, on analysis, to contain less than the guaranteed per-centages of the three substances already mentioned.

4. Mineral superphosphates should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of soluble phosphate of lime, at a certain price per unit per cent, no value to be attached to insoluble phosphates.

5. Nitrate of soda should be guaranteed by the vendor to contain from 94 to 95 per cent of pure nitrate.

6. Compound artificial manures should be purchased in the same manner and with the same guarantees as dissolved bones.

7. Sulphate of ammonia should be guaranteed by the vendor to contain not less than 23 per cent of ammonia.

8. Peruvian guano should be sold under that name, and guaranteed to be in a dry and friable condition and to contain a certain percentage of ammonia.

N. B.—Artificial manures should be guaranteed to be in a sufficiently dry and powdery condition to admit of distribution by the drill.* A sample for analysis should be taken, not later than three days after delivery by emptying several bags, mixing the contents together, and filling two tins holding about half a pound each, in the presence of a witness. Both the tins should be sealed, one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.—

AGRICULTOR.

GENTLEMEN,—Referring to the useful rules to guide purchasers of artificial manures in the letter of your correspondent "Agricultor," I would be disposed to subscribe to them all, preserving a right of private judgment in the case of No. 4, where it is stated that in mineral superphosphates no value is to be allowed to

* Manures are generally mixed with a large proportion of sifted burnt earth preparatory to distribution, and there is inside the manure box on the drill a roller with teeth placed at intervals driven by a cog-wheel or axle of the wheels of the drill to better insure the pulverisation of the mixture.

insoluble phosphates. Scientific opinion on this point is, at present, in a state of transition, as there is no doubt this rule bears too hardly upon the manufacturer. Provided the insoluble phosphate is in a fine state of division, a value should be allowed to it for two reasons. First, it may consist of phosphate that has not been dissolved, in which case its value, provided of course it be phosphate of lime not phosphate of alumina, should be considered equal to phosphate in ground coprolite. However, as undissolved mineral phosphate is almost universally considered greatly inferior to undissolved bone phosphate, the rule would have a decidedly salutary effect in causing manufacturers to turn all the phosphate into the soluble form; but it happens that what is condemned as insoluble mineral phosphate commonly contains a proportion of dissolved phosphate that has reverted to an insoluble form which is little inferior and probably in the potent climate of Ceylon is quite equal to the soluble phosphate, so that it is a manifest injustice to the manufacturer not to allow anything for it because it is practically insoluble in water. Some eminent chemists hold that all the soluble phosphate reverts to the form insoluble in water in the soil before it is taken up by the plant and that the only advantage which the initial solubility gives it, is a greater diffusive power before it reverts. When alkaline substances such as ashes are mixed with soluble phosphates much of the latter reverts.

In Belgium, agricultural chemists are decidedly ahead of us in their mode of valuing phosphates. Mr. K. Walter, Chemical Engineer, Aurelais, Belgium, informs us in the *Chemical News*, "that it was announced that from the 1st January 1878 in all phosphates coming under the control of the Belgian agricultural stations, all phosphoric acid soluble in citrate of ammonia must be counted assimilable and of the same value as soluble in water." The same authority informs us, "There are soils in which a given weight of a natural phosphate of say 20 per cent of phosphoric acid has the same effect as the same weight of superphosphate of 12 to 14 per cent. of phosphoric acid; but the price of the first would be £1 15s or less, while the price of the latter is at least £4 per ton." And again, "Some of the French mineral phosphates when finely ground are excellent manure. For fresh broken woodland, turfy ground and soils rich in humic acids they are superior to superphosphates."

The careful experiments of Mr. Thomas Jamieson, F. C. S., chemist to the Aberdeenshire Agricultural Association, led him to the conclusion "that for the

turnip crop the most economical phosphatic manure was insoluble phosphate of lime *from any source* ground down to an impalpable powder." It is only natural for us to expect that in Ceylon, with its command of bone manure and forcing climate, economy will lie in the direction of improved grinding, so as to get the natural phosphates into a state of impalpable powder rather than in the importation of superphosphates.

Referring again to Dr. Voelcker's useful rules No. 6 shews that he quite agrees with the lae Professor Anderson and all other eminent chemista, in disregarding carbonate of lime in the commercial valuation of compound manures, such being always expected to shew their value from their nitrogen and phosphates. Mr. Hughes seems to be of opinion that the potency of a tropical climate, coupled with scarcity of lime in the soil, justifies a more liberal treatment of this ingredient. Such recognition can affect the analyst at least only favourably, so that it may be left an open question between buyer and seller in the case of poudrette. Were I a buyer, however (except in the case of pure wood ashes which do not properly come under the head of compound manure), I would stick to the good old rule, as it keeps the manures pure and so prevents the artificial manure trade from becoming demoralised.

Potash so rarely occurs in ordinary artificial manures in England in appreciable quantity that Dr. Voelcker has not taken account of it in these rules; but whenever it occurs in fair proportion a high value is assigned to it. As nitrogen assists plants to assimilate potash so potash assists plants to assimilate nitrogen.—

MICHAL COCHRAN.

HINTS FOR THE CONSIDERATION OF COFFEE-PLANTERS.

(*From the Ceylon Observer, March* 15th, 1880.)

An experienced and observant visiting agent hazarded the opinion to us the other day that in many parts of the younger districts coffee has been planted too widely apart. He remarked on the smaller number of feeding rootlets found on trees which have grown up in the leaf disease period than on those which date back previous to the appearance of this scourge, and intimated his belief that trees with a poor display of rootlets planted widely apart were unable to absorb a due proportion of the moisture in the soil. The consequence of this was that the soil

turned sour and injured the trees. It will be at once suggested that grub may account for the poor display of rootlets in many localities; but very possibly repeated attacks of leal disease are no less to blame, and it would seem possible now, that, as a planting community, we ought to have paid more particular attention to our nursery seed since 1869, perhaps treating it as South Australian farmers do their wheat for rust before sowing. Rust, like leaf disease, is purely external in its action, but the spores are ubiquitous—on the straw and seed (on the trees and beans), and while the former is burnt, the latter is rubbed in lime or ashes. Coffee seed so treated might possibly escape early attacks of the disease in the nursery. Still more important is the question raised by our intelligent correspondent, Mr. Crickitt, who also bases his argument on the parallel experience gained in the case of pedigree wheat, and more lately with specially selected potatoes. There is certainly grave reason why any further nurseries of coffee in Ceylon should be sown with foreign seed, which, however, ought in every case to be rubbed in ashes or dipped in a solution of sulphate of copper to get rid of external spores, before planting. Experiments in this direction are well worthy of attention.

It is sometimes remarked that careless planting, turned-up roots, poor plants and small holes have a good deal to do with weak coffee and short crops in the younger districts. The foolish boast of many pioneers about the hundreds of acres they planted each season has only to be recalled to remind us of the practice of planters of the best type in the old favourite districts, never to add more than fifty acres to cultivation under one superintendent in one year. This ensured proper supervision of the work and a careful selection of plants. There can be no doubt that the valuator or purchaser of a plantation now-a-days ought to be particular in his enquiries as to the planting and the reputation of the man under whose care the work was done.

Our system of clean weeding is now challenged, and reasons are adduced sufficient to warrant experiments in another direction. Certain old Uva planters hazard the opinion that coffee flourished better in the era when clean weeding was unknown! "Often," says a well-known visiting agent, "have I called the "attention of young Dikoya planters to Abboo Drahim's "estate in Ambagamuwa with its succession of heavy "crops and his system of no weeding during the crop "season, thereby possibly helping to give his trees a "much-needed rest in growth." Weeds, it is supposed,

would supply food for grub, prevent wash, save the unshaded earth from being baked, and when dug into the soil supply nutrition for the coffee. On the other hand as was stated the other day, our prevailing white weed is regarded as a serious rival to coffee in its demands on the soil. A possible further reason for permitting weeds to grow is suggested to us in the following extract from the London *Athenæum* of January 24th :—

"CHEMICAL.—Jan. 15.—Mr. Warren De La Rue, President, in the chair.—The following paper was read : 'On the effects of the growth of plants on the amount of matter removed from the soil by rain,' by Dr. J. H. Prevost. Soil three inches deep was placed in two glazed earthenware pans, seventeen inches in diameter ; on July 21st four grm. of white clover seed were sown in one, the other being blank. The pans were exposed till October 4th ; the drainage water was collected and analyzed ; that from the clover soil contained 48·1 grains of solid matter per gallon, the the other 220. The auther concludes that rain removes much more matter from an uncropped than from a cropped soil."

It is pointed out, however, that the conditions of our soil and rainfall are widely different, the latter often mechanically washing off the surface soil,—rather than percolating for any depth.

Whether the present very unusual thunderstorms will have any effect on the prevalence of leaf disease is a subject worthy of observation in different districts. If we are to find an explanation of the wonderful spread of *hemileia vastatrix* since 1869, in an attempt of nature to restore the balance to our atmosphere, by reducing a superfluity oxygen, than we might suppose electricity to come in as a great aid, and even as superseding the need for active fungoid life. But this is a mere matter of speculation, and many years of scientific observation would be required to verify such an idea. For the present we must wait to see if Dr. Trimen and Mr. Ward can throw further light on the mystery surrounding the origin, cause and conditions of *hemileia vastatrix*, and above all, can tell us how to prevent or modify its attacks.

COFFEE TREES IN 1870 AND 1880.

Commenting on our "Hints for the Consideration of Planters," a gentleman of experience in coffee writes as follows :—

"The coffee tree of 1880 is not the same robust healthy plant that it was in the days prior to leaf

disease, and this I submit is demonstrated more by the absence of rootlets than anything else. Ten years ago the ground was a perfect network of feeding rootlets, and the moisture in the soil was as a natural consequence absorbed more thoroughly. Now, what have we? Trees with not half the number of roots, water accumulates, sours the soil, the roots are damaged, and grub accomplish the rest. But you will say—'Stop a moment, how is it that the coffee tree of 1880 is so weak and unhealthy?' To this, of course, I can only say what I believe to be the origin and that is leaf disease. In my opinion the continued attacks of this fungus have had a weakening effect on the offspring, and as a proof of this I would ask you to go with me over any one of the clearings opened last year or even the year before. Select your own, let it be either in the young or old districts. Shew me one that can compare with the clearings of four or five years ago. But perhaps the failure of these clearings is due to bad plants or bad work. To this I reply that although a combination of these two evils is sufficient to account for the failure of a few, it is not likely that all the clearings last year laboured under similar disadvantanges, and yet I can honestly say I don't know *one* that can hold a candle to the fine luxuriant fields of young coffee we were so proud of a few years ago. Then again taken the nurseries. Four or five years ago, nothing was easier than to raise successful coffee nurseries; *now* a good one is the exception not the rule. 'T is true we have not been half careful enough in the selection of seed, and I quite agree with you that in future disinfecting should be always resorted to, but how do you account for the fact that the parchment is now so inferior to what it used to be? All the brokers will tell you that the samples this year have been vilely bad.

"Now a word or two about *grub*. I do not at all agree with Mr. Dixon, but I *do* think that in the case of Maskeliya and parts of Dimbula, other agencies are at work, and it is the damaged condition of the roots that first attracts them—once there, they are not very particular and demolish good as well as bad. An abnormal supply of moisture in the soil has I believe more to do with our misfortunes than anything else—it rots the roots and sours the soil. Close planting is, in my opinion, the best remedy, for I see no other way of getting sufficient roots to absorb it. Lime and cultivation generally have been tried on several places with little or no effect. Planters will say, the objection to close planting is that

the trees spoil each other. To my mind there is unfortunately not much fear of this, and even if there was, you could easily get rid of some of the primaries. What we want is to tap the soil of superfluous moisture, and this cannot, I submit, be accomplished by any system of drainage, however complete, UNLESS THERE ARE PLENTY OF FEEDING ROOTLETS. On two closely planted estates at least within my knowledge in the young districts, the return in crops has been much above the average."

AN ANSWER TO THE ABOVE.

A planter writing a few days ago preferred a general challenge in reference to coffee clearings of the last few seasons which we are glad to say has been accepted. His words were :—

"In my opinion the continued attacks of the coffee leaf fungus have had a weakening effect on the offspring, and as a proof of this I would ask you to go with me over any one of the clearings opened last year or even the year before. Select your own, let it be either in the young or old districts. Shew me one that can compare with the clearing of four or five years ago."

Now in answer a visiting agent has been good enough to refer us to a 50-acre clearing on Doongalla plantation, Maturata district, belonging to Mr. G. B. Sparkes. The coffee is two years old and as rich, healthy, strong and full of crop as any two year old clearing in the old palmy days of coffee. The second instance is even more striking, although in the far-famed Haputale district. It refers to a 20-acre coffee clearing on *patana land* at an elevation of 4,500 feet above sea level, planted in Nov.-Dec. 1877, and now therefore 2⅓ years old. Already there has been picked from this field crop equal to 2 cwts. per acre, and fully another hundredweight remains on the trees. This shews what patana land in Uva, well selected and cared for, may be expected to do.

PEDIGREE WHEAT AND DISEASE-PROOF POTATOES; AND WHY NOT FUNGUS-PROOF COFFEE.

To the Editor, Ceylon Observer.

London, 21st Jan. 1880.

SIR,—The last time I wrote to you on the subject of the coffee leaf disease, I stated that Hallett's pedigree wheat was free from rust and disease, as a proof that liability to disease in plants was constitutional. In your remarks on it, you said that if that were so it would be a case for consideration.

Lately I have had the advantage of an interview with Major Hallett, and he has not only confirmed

my assertion, but he has furnished me with a still stronger proof of the truth of my theory.

The potato, as no doubt you are practically aware, has now long been subject to a disease of a fungoid nature, first attacking the leaf, then descending the stem to the root.

It struck Major Hallett that the same treatment that he had so successfully applied to cereals was worth trying on the potato, and the result has been that after a few generations he attained a race of potatoes which are to all appearance and practically free from disease. He tells me that this year he had a crop from his pedigree potatoes entirely free from disease, though grown close by the side of another lot from ordinary seed that were very badly diseased. The past year has been one of the worst seasons for disease among potatoes that we have had since 1846.

Do not these facts give us hopes, that there is yet another way of extirpating coffee leaf disease, namely, by selecting and only propagating plants from selected seed of the healthiest plants that can be found and continuing the selection for three or four generations? Of course in the case of the coffee plant, this will take some years, and is therefore a matter that the island should expect to be carried out by the Government for the benefit of the coffee interests, which so largely supplies the revenue, and should not be left to the planter who has to struggle with the disease amongst the existing race of plants, which should, I more than ever think, be principally based on the principle of restoring health of constitution to the plants by scientific manuring and shade planting.

I send you various papers printed on Major Hallett's pedigree wheat, barley, oats and potatoes for your perusal, and would mention that the same system has been tried with success on a vineyard that was attacked by disease.—Yours faithfully,

Robt. E. Crickitt.

The Pedigree System is tolerably sound in principle yet I could give instances of its non-useful effect. As for the coffee now under cultivation it is of no avail, but for new plantations care should be bestowed on the selection of seed from healthy trees, as well as on disinfection before planting. This is only the survival of the fittest over again. I have seen on several occasions the heads of pedigree wheat, but not growing.—*Cor.*

ON MANURING COFFEE,

1. *Ash of Coffee.*—I think Mr. Cochran is mistaken in stating the percentage of ash at 4%. I got some berries calcined in the Laboratory of King's College last year, and the result was $2\frac{1}{2}$°/₀.

2. *Sources of Potash.*—You have fallen into a very natural error in supposing that I recommended kainit salts. The large percentage of common salt in them renders them very liable to deliquesce, besides forming a heavy percentage of freight. It is practically better and cheaper to use a less quantity of the best muriate of potash, an invoice of which lies before me giving 88 % of muriate equal to about 47°/₀ pure potash against 13 or 14°/₀ in kainit, the former costing £7 16s – the latter £2 10s per ton—freight being the same. Both come from Germany, and there is an intermedtae sulphate of potash containing 27°/₀ pure potash to be had for £4 15s per ton, which I intend trying.

3. *Lime.*—I have observed a disposition in some of your correspondents to treat lime as a manure instead of a fuel or solvent. The old farming proverb is a very true one:—

> "Lime and lime without manure
> Makes both soil and farmer poor."

And I would suggest another as equally sound:—

> "First manure and then lime,
> Will surely give good crops in time."

Can you not calcine your stores of oyster-shells at the pearl banks, or coral or limestone nearer at hand, and spread a few cwts per acre broadcast every three years? In this way you would best digest into soluble food the potash in your slowly decomposing felspar, as well as the other necessary ingredients in both soils and manures, as the Sussex farmers have done by liberally liming their stiff Wealden clays.

4. *Phosphates.*—You may not be aware that an abundant source of phosphate lies within easy reach of Ceylon, in what is called the guano of the Lacipede islands off the coast of Western Australia. It *was* a guano ages ago no doubt; innumerable monsoons have washed out the ammonia, and though it still resembles guano in colour, it is in reality a phosphate, or more correctly, a guano-phosphate, I give you the analysis of a sample:—

Moisture	24·13	
Water of combination and organic matter	7·92	
Phosphoric acid ...	28·57	= Tribasic phosphate
Lime...	35·21	of lime 62·37
Oxide of iron... ...	3·48	
Insoluble matter ...	00·69	
	100·00	

What it cost at the islands I cannot tell you, but it has been sold in London at £4 to £5 per ton, and mixed with ammonia and potash it ought to be an excellent manure for coffee. Here it is used for superphosphate, but after all sulphuric acid only does quickly what dame nature does for us slowly and surely in her own way, and I am not sure that the advantage of using superphosphate with coffee, is as great as with annual crops of different kinds, when it may be required for use, and not for the two following.

5. *A Perfect Manure.*—Ammonia, phosphoric acid and potash in some from or other and in due proportions, are what we have to combine to from a perfect manure, and the soil analysis is mainly valuable in indicating any partial weakness, which can be strengthened accordingly. Mr. Hughes is, I believe, mistaken [as Mr. Cochran justly points out in his letter of 20th June] in considering any of the soils in Ceylon, the analysis of which you have published, sufficiently rich in potash to dispense with its liberal use in manure, and if the Indian soils I quoted, with double the potash of your Dimbula and Haputale soils, require 10 per cent of potash in a proper manure, according to Dr. Voelcker and Mr. Dyer, it appears to me folly to give less or more to the latter. Doctors may differ, it is true, but I think that in this case the more experienced practitioners are the safest to follow. As men of business, it is our province to ascertain how we can best work out their prescriptions practically, and I am confident that not only is there no necessity to pay high prices for quack remedies, but that coffee can be much better manured for R30 per acre that it is now in many cases for double and trouble the money. Good farming does not consist in squandering money, but in getting the utmost benefit at the least cost.

6. *Leaf Disease.*—After all that has been written on this subject, I see no reason to believe otherwise than that leaf disease is nothing but nature's own punishment for our neglect of her laws and our folly in looking for miraculous growth of coffee when year after year we have been eating up our soil capital just as the southeners have eaten up Virginia and others of their most fertile states. Sulphuring is an old and very doubtful remedy for a similar disease in hops, and no doubt about as useful as it is in certain forms of skin disease; it may palliate, but if we want to effect a *cure* we must stick to constitutional treatment, and nothing else will serve our pur-

pose effectually, as the vine growers of France have found.

H. TOLPUTT.

32, Great St. Helens, London, 31st July 1879.

P.S.—Since writing the foregoing, I am able to furnish you with a strong confirmation of my first remarks on the importance of potash. Here are analysis of three soils from another part of India :

	No. 1	No. 2	No. 3
Lime ...	·410	·393	·263
Potash ...	·283	·244	·418
Phosphoric acid	·045	·050	·032

and you will observe the percentage of potash is higher than in any you have published, particularly No. 3, which is the highest I have seen anywhere. They are from estates which have been starved and mismanaged, and of the third an old superintendent remarks, on hearing that it had borne a moderate crop last season, "You see all their bullying has n't killed it!" The report accompanying the analysis points out the low percentage of phosphoric acid as the prominent feature which calls for attention, and a liberal supply of phosphatic manures. Liming is recommended, if not too expensive, both as increasing the quantity in the soil, and rendering the potash more availabl as plant food, than it probably is in the condition in which it already exists in the land. The para. on this subject concludes as follows :—"I should not at the same time advise you to dispense by any means with artificial potash, merely because the percentage of potash is equal to a little above the average." This is sound advice which I intend to follw.—H. T.

Colombo, 15th Oct. 1879.

Mr. Tolputt, in referring to my letter of 17th June, where the words occur: "Allowing 4 per cent of ash in the coffee *bean*," &c., seems to have thought I was speaking of the coffee *berry*, which he says, no doubt truly enough, is $2\frac{1}{2}$ °/₀. I have never before seen an estimation of the ash in the berry, by which I understand the dried cherry.

I made the statement on the authority of the great food analyst, Dr. Hassall, who gives the following figures :—

		Percentage of Ash.
Mysore coffee	...	4·29
East Indian coffee	...	4·07
Jamaica ...	...	4·59

The following analysis of coffee by Hassall may

be interesting, although he does not state where it was grown :—

	Raw coffee.	Roasted coffee.
Water	8·26	0·36
Cane sugar	8·18	1·84
Caffeine	1·10	1·06
Fat	11·42	8·30
Gluten	10.68	12·03
*Extractive matter ...	14·03	26·28
Cellulose, &c.	42·36	44·96
Ash	3·97	5·17
	100·00	100·00

* Caramel, gum, tannin, &c.

M. Cochran.

From Mr. J. B. Lawes.

I have recently seen an article in your paper of the 16th June headed "Potash as the Dominant Element in the Crop, a Necessary Ingredient in Coffee Manures." A few remarks I venture to make may be of some service to those who cultivate this valuable product. The term "dominant" is somewhat misleading and possibly I may not fully understand what it implies. I will, however, assume its meaning to be that land under the ordinary circumstances of coffee cultivation is more likely to be deficient in potash than in any other element of plant food, consequently an application of a salt of potash would produce a more beneficial effect than any other separate ingredient. In this sense a salt of ammonia may be considered the dominant element in a manure for wheat. We have applied ammonia for 36 years in succession to wheat, and the produce is still higher than the produce obtained by the application of potash, soda, magnesia and superphosphate of lime without ammonia. The reason why ammonia or nitric acid is so superior in its effect upon this crop to all other manure ingredients has been explained by me elsewhere. As experiments similar to my own have not been carried out on coffee, we can only reason upon the probabilities of one or other of the various elements of plant food being dominant, and I should not be very much surprised if further experiments proved that no special ingredient had a predominant influence over the others. My reason for this conclusion is founded upon the fact that coffee grows up as a perennial shrub, and is not an annual plant like many of our ordinary cultivated plants ; its roots therefore penetrate deeper and have more complete possession of the soil. Assuming that five cwts. of berries is a fair crop, the

amount of mineral matter taken from an acre of land will be about 28 lb., of which 15 lb. will be potash. Compared with most of our cultivated crops, this amount of potash is but small, and I should be disposed to think that a soil exhausted by coffee growing or a soil not sufficiently rich to grow coffee without manure would not be much benefited by the application of potash salts. Judging from the character of the plant and from the large amount of washing which the soil it grows in is exposed to, I should consider that the most suitable manures to use would be those which contain organic nitrogen, rather than such manures as nitrate of soda, or sulphate of ammonia. Rape or poonac cake, dried flesh [? fish.—Ed. C.O.], shoddy mixed with finely ground bone, would accord with my ideas of a good coffee manure; some of these would supply potash in sufficient quantities. In bones and shoddy, where it is almost absent, perhaps a little potash would be useful. Manures made by feeding stock would be undoubtedly valuable, but this sort of manure is by no means economical unless the animal fed increases in value. To employ animals merely to turn food into manures cannot be recommended, and it is probable that, of the two, artificial compounds would prove the cheapes. Judging from the analyses of coffee soils which I have seen, potash appears to be present in considerable quantities, and I should be disposed to rely upon the soil to supply this substance together with the small amount which the manures I have recommended the use of would contain, and not to expend money in the purchase of salts of potash.

(Signed) J. B. Lawes,

August 1879. Rothamsted.

ARTIFICIAL MANURES *VERSUS* CATTLE MANURE:

KEEPING CATTLE FOR MANURING ALONE ABSOLUTELY UNPROFITABLE.

THE POSITIVE NEED FOR ARTIFICIAL EXTRANEOUS MANURES.

THE ELEMENTS TO BE SUPPLIED TO SOIL AND THE BEST MIXTURES.

The great prophet of the new system of agriculture which dispenses with the rotation system, with the setting aside of from 50 to 70 per cent of a farm for grazing purposes, and also with farm-yard manures, if M. Georges Ville, a Frenchman, whose work, trans-

lated by Crookes and published by Longmans, possesses all the interest of a sensational novel. When we say that the new system dispenses with cattle manure we do not mean that M. Ville undervalues this substance, especially when mixed with artificial manures. But what he insists on is that farmyard manure pays only when the animals who produce it perform the labour of the farm, and when it has to be carried only a short distance. And even under the most favourable conditions, farming by *only* the manures produced on a farm, taken, in fact, from its own substance, cannot pay. There is considerable loss when animals fed on a farm are removed from it, but when successive crops are removed, the very elements on which the fertility of the soil depends gradually disappear, and, unless fertilizers from abroad are introduced, the land will inevitably become sterile. If portions of a farm are left in pasture, the French professor insists on the necessity of manuring this pasture land just as much as the arable portion of the farm. From the fact that the lectures of which the book is composed were delivered in France, much attention is devoted to beet-root culture, and what concerns us more closely, the effect of certain manures on sugar-cane culture, is adduced. We say that this affects us more closely, because it is certain that, as a general rule, the manures which are good for sugar-cane and wheat are good for coffee. To the culture of the latter plant there is no allusion in M, Ville's disquisitions, but, after reading his work, we feel certain that on visiting a coffee estate and seeing a certain proportion of the land set aside for the growth of guinea-grass to feed cattle, he would at once ask whether, with the addition of oil-cake, the cattle were rapidly fattened for a good market, or whether the animals were utilized for draught purposes of a paying nature either on or beyond the plantation. If told that it paid to keep cattle simply for their manure, such cattle being wholly or mainly fed on grass grown on a portion of the estate capable of growing coffee, tea, cinchona or cacao, we suspect he would put some very searching questions of the "Will it pay?" order. He would be told that, although the price of dead meat is anomalously high, the market for fat cattle is neither extensive nor very remunerative, and that what with cost of food (working bullocks requiring something more than grass) and the competition of human labour (for short distances), it was questionable whether the work done on the estate or the hire earned (or saved) beyond it paid for attendance and keep. The qualifications would, however, be mentioned,

that cattle were valuable as relieving coolies of work which they disliked, while the manure yielded even by non-working cattle was valuable, with pulp and "ravine stuff" to supplement artificial manures which in many portions of this country became excessively costly, not merely by the freight charges from Europe, India, Australia, &c., to the port of import, but by the fearful cost of land carriage when conducted for long distances by cattle. It would have to be added that, high as the cost was, the bullock bandy owners made often a loss rather than a profit, from the expensiveness of cattle food, and the effects of hard work and exposure in this wet climate on the cattle themselves. He would soon see that our great want was EXTENSION OF CHEAP FACILITIES OF CARRIAGE BY RAILWAY. But, even as matter stand, we suspect he would shake his head about keeping cattle merely for their manure and recommend planters instead to use what he calls his "NORMAL MANURE" consisting of nitrogen, phosphoric acid, potash and lime. The other ten ingredients of plants exist in all soils, or are yielded by the air, and need not be supplied. Not only the vegetation but the cattle fed on it are made up of 16 parts, 4 only of which have to be supplied in feedthem! Leaving cattle aside, for the present let us look at the composition of such a grain as wheat, straw and grain. According to M. Ville 93·55 parts are derived from the air :—

Carbon (not far short of one-half of the plant)...	47·69
Hydrogen	5·54
Oxygen	40·42

Then come 3·386 per cent of constituents with which the soil is *superabundantly provided and which it is quite necessary to add to it, viz.* :—

Soda... ...	0·09
Magnesia	0·20
Sulphuric acid	0·31
Chlorine	0·03
Ferric oxide	0·006
Silica	2·75
Manganese	?

And now, most important of all to the practical agriculturist, we come to 3 per cent of constituents which the soil possesses only to a limited extent, and the deficiency of which must be supplied by artificial manure, *viz.* :—

Nitrogen	1·60
Phosphoric acid...	0·45
Potash	0·66
Lime...	0·29

The principles here exemplified holding good in all cases, although of course certain soils are rich in the main elements of fertility while others are deficient (M. Ville analyses the soil by growing plants in patches of it), the use of certain combinations of the four substances last noticed are recommended, by means of which a soil can be made to yield profitable crops continuously while it positively improves in quality instead of being exhausted. For a wheat crop of 33 bushels per acre, per annum, M. Ville would apply a dressing consisting of

	Per acre.	*Cost,*
Calcic superphosphate ...	176 lb	£0 7s 8d
Potassic chloride at 80°	88 ,,	0 6s 5d
Ammonia sulphate ...	171 ,,	1 11s 2d
Calcic sulphate ...	93 ,,	0 0 8d
Total...	528 lb	£2 5s 11d

The "calcic sulphate" of this receipt is just gypsum or plaster of Paris, and there can be no doubt that the above would form an excellent application to coffee. The cost, however, we fear would have to be quadrupled. M. Ville has the strongest possible belief, which we share, that chemical science will yet discover a mode of extracting from the atmosphere all the nitrogen required in agriculture. As it is, certain plants, notably the legumes, absorb very large quantities, and hence the value of vetches, lupins, &c., ploughed green into the soil. We do not know to what extent the coffee tree, which is popularly regarded as yielding "beans," derives nitrogen from the atmosphere, but M. Ville classes sugar-cane with turnips, seeds, Jerusalem artichokes, sorghum and maize as needing no nitrogen (ammonia) in the manure applied to its culture. The mixture he recommends in this case consists of lime in two forms and of potash thus :—

	Per acre.	*Cost.*
Calcic superhosphate...	528 lb.	£1 3s 0d
Potassic nitrate ...	176 ,,	1 18s 4d
Calcic sulphate ...	352 ,,	0 2s 6d
Total...	1,056 lb	£3 4s 0d

If we could afford to give our coffee trees about 9 cwts. per acre of such a mixture as the above, we have no doubt the response in the shape of crop would be large, but we suppose that in this case also we should have to calculate on at least a quadruple cost, say £12 per acre? That is the difficulty—the one of cost —of the coffee planter in experimenting with a adopting system of manuring, however, strongly recommended.

The system which, by means of a copious use of artificial manures, M. Ville has inaugurated at Vincennes, the naturally poor soils of which are made to yield large and profitable crops year by year, he calls "Free and continual rotation: stable manure mixed with chemical manure." The coloured square for this system is, like that devoted to the irrigation system, without any subdivisions. We have instead the words :—

"Absolute freedom
Meadow or arable
The crops are double those grown on the other systems."

By the words "meadow or arable," is of course meant, that by the new system either the whole or part of a farm can be devoted to meadow for the profitable feeding of cattle, the meadow land being heavily manured with suitable substances, and the cattle fattened with substances other than the grass or clover. But, although in such cases the cattle manure may be utilized, its effect being enormously increased by the addition of chemical manures, the object is not to grow grass &c., to feed cattle *for the sake of their manure.* If converting the whole of the land into arable is deemed the better and more profitable course, byre and stable manure can be entirely dispensed with and maximum crops obtained by the use of four substances applied according to what is found to be the dominant principle of the particular plant. The four substances required, sometimes the whole of them and sometimes only three or even two, are, as we mentioned in our previous article :—

Nitrogen,
Phosphoric acid,
Potash,
Lime.

Now, judging by the composition of the ashes of the bean, potash ought, we suppose, to be regarded as the dominant principle in coffee, But before preparing a manure for coffee, Mr. Ville would inform himself of the composition of the soil to which the manure was to be applied, and he would learn that on young estates, such as those of Dimbula, Dikoya or Maskeliya generally, there was a considerable store of potash derived from the forest burnt on the ground, in the clay of the soil, and in the gradually decomposing felspar of the rocks. M. Ville, who distinctly recognizes the value of clay as a receptacle of potash, would, we suspect, join Mr. Hughes in stating that, for soils like those we have alluded to, the application of potash was not so much needed as treatment, such as forking and liming, which would render the stored-up potash available. We are

bound, however, to add, that the French writer makes light of the popular argument in favour of cattle manure as improving the *mechanical* condition of the soil. He contends that much larger crops and more profitable are obtained by means of artificial manures, the mechanical condition of the soil being improved otherwise—by careful culture of course. By the carbonaceous matter contained in cattle manure, M. Ville would, and probably with justice, set little store, seeing that plants derive the large proportion of carbon of which they are composed (nearly 48 per cent in the case of wheat) from the atmosphere. Indeed, when we add together the constituents which plants derive from air and water, the remaining balance is very slight as a percentage. But even fractions of certain substances, phosphoric acid, for example, are of enormous importance. We can feel as we read this book that it is not so much nitrogen and potash as phosphoric acid, lime and culture which *young* coffee estates need, as Mr. Hughes pointed out. In the case of old estates, or young ones after they have borne several heavy crops, however, the dominant principle in the crop removed must certainly be supplied. If we are to judge by the ashes of the coffee beans, the dominant element (50 to even 55 per cent) is potash. Now let us see what are the combinations which M. Ville advises to be used in the case of plants, the dominant principle of which is potash. For potatoes and flax his normal manure is composed of

	lb. per acre.
Calcic superphosphate	352
Potassic nitrate	264
Calcic sulphate	264
	880

That for vines and fruit trees would, no doubt, be more suitable for coffee, viz :—

Calcic superphosphate	528
Potassic nitrate	440
Calcic sulphate	352
	1,320

This is nearly 11 cwt. per acre of substances which (even the gypsum) would be costly on coffee estates. In both the above cases the amount of nitrogen contained in the potassic nitrate is considered sufficient in addition to what is derived from the air and rain. But for vines and fruit trees there is a "homologous manure," being of the same composition as the normal manure, only that the potassic nitrate is replaced by a mixture of

potassic chloride and ammonic sulphate, thus:—

	lb. per acre.
Calcic superphosphate	528
Potassic chloride at 80	440
Ammonic sulphate	308
Calcic sulphate	44
	1,320

Potassic chloride has the advantage of being cheaper than the nitrate. It is composed of potassium 52·41 per cent, and chlorine 47·59, the first-named constituent being equal to 63·16 of potash. The price of this substance when M. Ville wrote was 7s 2d to 8s per cwt., against £1 4s for the nitrate. To Ceylon planters it will be important to learn that "Since the discovery of the Stassforth mines, the price of this salt cannot fluctuate much, as the supply exceeds the demand." We believe there have been some importations of this valuable source of potash into Ceylon, by an estate agency house, but we have not heard the result of their experience. Ammonic sulphate is mixed with this substance, no doubt to supply nitrogen. Once again we have for vines and fruit trees a normal homologous manure where calcic superphosphate is replaced by *precipitated* calcic, thus:—

	lb. per acre.
Precipitated calcic phosphate ...	220
Potassic nitrate	440
Calcic sulphate	220
	880

The merits of precipitated phosphates are its greater cheapness, its more certain action, superphosphate being rather too soluble for newly-opened lands.

What puts fruit on vines, would, we should think, put fruit on coffee trees, and by his manure M. Ville obtained a heavy crop, which vines left unmanured yielded absolutely nothing. This case is strikingly illustrated by engravings of the contrasted plants. But as our new soils at least are fairly supplied with nitrogen and potash, perhaps we had better look at the composition of the manures which M. Ville recommends for plants in which the dominant ingredient is supplied by calcic phosphate, such as maize, *sugar cane*, sorgho, and Jerusalem artichoke. The normal manure in this case is composed of.

	lb. per acre.
Calcic superphosphate	528
Potassic nitrate	440
Calcic sulphate	352
	1,056

And if a normal stimulating manure is required, 53 lb. of ammonic sulphate is substituted for an equal quantity deducted from calcic sulphate. It will be interesting to our readers to hear that M. Ville prefers to apply the lime in his manures in the shape of gypsum. He states: "Calcic sulphate is nothing more than unburnt plaster of Paris, and is composed of sulphuric acid and lime. It is found in nature in large quantities in the form of hydrate :—

	per cent.
Sulphuric acid...	46 51
Lime	32·56
Water	20·93

Exposed to a temperature of 248° to 266° F., it loses its water and passes into the state of anhydrous sulphate, more commonly known as plaster of Paris. In using calcic sulphate I prefer it in this state. It is worth about 8½d per cwt. It can also be used in the form of raw gypsum, only in this case the proportion must be increased one-fifth." Of course gypsum is not likely to be obtained in Ceylon for less than many times 8½d per cwt. But we suppose. if sulphuric acid were available, the lime from burnt coral could easily be converted from a carbonate into a sulphate? So many things are waiting to be done, when sulphuric acid is locally manufactured and cheaply as well as plentifully supplied. We could then for ourselves convert bones into calcic superphosphate, the most valuable ingredient (though not the most costly) in all manures. M. Ville expresses his intention to write a manual for the instruction of cultivators in this process. Meantime M. Ville is of opinion that the price of calcic phosphates is more likely to fall than to rise, looking at the fact that they (bones apart) enter into the composition of all eruptive rocks. He alludes to the large deposits in Estremadura in Spain containing 70 to 80 per cent of calcic phosphate. In Canada, Sweden and France there are also deposits. After noticing the process by which calcic phosphates are converted into superphosphate, preferable generally on account of its superior solubility, M. Ville proceeds to notice exceptions in which bi- and tri-calcic phosphates are more beneficial, viz., *newly cleared land* and damp meadows. Our readers will notice that M. Ville does not apply nitrogen in the form of oil cakes, so largely used in Ceylon. He, however, fully recognizes the value of such substances, *if entirely deprived of the oil, which has no manurial value.* If cakes contain any oil he gives directions for extracting it by means of chloroform, or by carbon bisulphide, or the light petroleums or coal oils. He writes : "These cakes are, in fact, very rich in nitrogen,

phosphates and potash. Dissolved in water we can by their aid prepare from them a sort of artificial urine, which if thrown into the manure pit effects the disintegration of the haulm husks and more especially the straw itself." This may afford a useful hint with reference to the maturing of composts. But we must close this article by giving the very heart of M. Ville's system. "The question then is," he says, "*Can we, with chemical manures, cutivate the same soil with uniform success? Yes, we can, but always on two conditions* :—

"(1) Return to the soil by the aid of manure *more* calcic phosphate, potash and lime than the crops have taken out of it.

"(2) Restore to the soil about 50 per cent of the nitrogen of the crops. I say about 50 per cent, because there are certain plants which require less, while others, leguminous plants for instance, seem to be able to do without any nitrogen being returned to the soil. We have already stated that part of the nitrogen required by plants is derived from the air, while some plants draw it more particularly from the soil.

"With respect to the calcic phosphate, potash and lime, the quantity restored must be in excess of that which is lost, because it is exclusively from the soil that plants draw them, and we must not only give compensation for the losses brought about by each harvest but also for those which are due to the solvent action of rain."

The bearing of these principles on coffee and other culture is obvious. We have to find out, in the case of coffee, what constituents are removed in crop, (parchment skin as well as clean beans) and no doubt we must make allowance to some extent for prunings and handlings, and to a large extent we fear for foliage lost by leaf disease.

190, Kollupitya Road, Dec. 6, 1879.

DEAR SIR,—The sanguine hope of M. Ville, that advanced agriculture will yet be able to draw all the nitrogen required for plant food from the atmosphere, lends a new interest to a subject touched upon in my last, viz., may not the secret of the lessened importance of the more active forms of nitrogen in our manures, compared to what obtains in temperate countries, be explained on the supposition that our atmospheric supply of available nitrogen is greater, either absolutely or relatively, to the products we have to cultivate? I am not aware if any tropical rains, dews, or atmosphere, have been made the subject of exact

analysis, so, in the absence of observed facts, it may be excusable to speculate a little on the subject.

There can be little doubt that the atmosphere is the primary source of the nitrogen in plants. The atmosphere is anterior to the soil in our cosmogony, is in fact the great agent by which the soils have been produced, and nitrogen not being a constituent of the primary rocks must have been absorbed from the atmosphere in the first instance ; ergo, all the nitrogen in plants comes directly or indirectly from the atmosphere ; so in this sense Ville's expectation is present reality. When one considers how important atmospheric combined nitrogen is to plants, this element constituting, according to Johnstone and Cameron, 1¾ per cent of their weight, it is matter for wonder that it should be present in such small proportion in the air, and one would be *a priori* disposed to credit the conclusion which Ville early arrived at from his experiments of 1849-1855 that plants can assimilate free nitrogen ; but English chemists are diametrically opposed to this view. It is so extremely difficult to estimate accurately the combined nitrogen in the air, that experimenters mostly confine themselves to the estimation of that in rain water. Perhaps the most reliable published results are those of Dr. Angus Smith, who gives the following :—

RAIN WATER IN PARTS PER MILLION.

Where collected.	Ammonia.	Albuminoid ammonia.	Nitric acid.
Ireland, Valencia... ...	·18	·03	·37
Scotland, five sea-coast country places, West...	·48	·1	·37
Scotland, eight sea-coast country places, East ...	·99	·11	·47
Scotland, twelve inland country places ...	·53	·04	·31
England, twelve inland country places ...	1·07	·11	·75

Calculating the averages we would get ammonia ·78, albuminoid ammonia ·08, and nitric acid ·49, or a total of ·835 of combined nitrogen in one million parts of rain water. Now the weight of a cubic inch of water is ·0361 lb., and an acre contains 6,272,640 square inches. A rainfall of one inch therefore weighs 226,442 lb. per acre of which ·189 lb. is nitrogen. A rainfall of 30 inches per annum would only supply 567 lb. of nitrogen per acre, a rainfall of 100 inches, like that of Ceylon, 18·9 lb. Suppose we take a crop of potatoes at not less than 4 tons per acre, of which 2·1 per cent is nitrogen ; no less than 188 lb. of nitrogen per acre would be carried away in a single crop of which the rainfall of the whole year could only supply 5·67 lb.

Coffee contains rather more nitrogen that the potash, viz., 2·14 per cent., not reckoning, for want of data, the parchment skin. A 5 cwt. crop thus carries away only 12 lb. of nitrogen, while our rainfall of 100 inches as per Smith's analysis contains nearly 7 lb. in excess of the demand for the crop. Mr. Horsfall assumes that 200 leaves are dropped per tree per annum ; Mr. Fraser of Damboolagalla assumes 2,000 : we may assume that while 2,000 are dropt 200 are irrecoverably lost by wind and wash. This according to Mr. Hughes would remove other 6·6 lb. of nitrogen per acre, still leaving a balance of 4 lb. to the credit of rainfall. If we knew what allowance to make for the parchment we should not have this balance ; but in any case the result would be very different from a heavy crop like the potato which carries away 182·3 lb. in excess of the calculated rain supply. It is found however, that the greater the rainfall the smaller is the percentage of nitrogen, vide table—east of Scotland has a smaller rainfall, but higher proportion of nitrogen, than the west of Scotland, and dew has a much higher proportion than ordinary rain.

But there is still another most important factor to be taken into account. Boussingault found that when the atmosphere was in a high electrical condition the proportion of nitric acid in the rain was enormously increased. In ordinary circumstances he found only about ·02 per 100,000 parts ; in a hail storm, however, the atmosphere being highly electrical, the rain contained not less than 5·5 and the melted hail 8·3 parts of that acid (*Hassal*). Let us suppose the rain and hail together contained no more than 7 ; an inch of such rainfall (and thunderstorms of an inch of rainfall are not uncommon in Ceylon) would contain 15·85 lb. of nitric acid, or rather more than 4 lb. of nitrogen, and an inch and a half of such rain would contain more nitrogen than the whole annual rainfall of 30 inches calculated from Dr. Angus Smith's analyses.

I have been informed by a Colombo gentleman who has collected rain during thunderstorms in Colombo, that he has been surprised at the strong smell that was shortly developed in it. This odour could be of no other than nitrogenous origin. I think, therefore, there is every reason to believe that the atmospheric supply of nitrogen to the plants, in the tropics, is greater than in temperate countries, and when the soil is prepared to receive this nitrogen, it so far replaces the necessity for nitrogenous manure.

I meant to have said a word about the fertilizing power of gyysum in the soil being less, if at all, due to its power of fixing atmospheric ammonia than to

other properties, especially the liberation of potash, but my letter has already extended to sufficient length.

M. COCHRAN, M.A., *Glasguensis.*

The one great discovery now to be made is that of producing ammonic sulphate from the nitrogen of the atmosphere. So important does M. Ville deem this question and so sanguine is he of a successful result, that he offers his own subscription of £40 towards a fund of £100,000 to reward the discoverer of a means of fixing the free nitrogen of the atmosphere. What seems the dream of this generation in this matter will, we feel satisfied, be realized. Another great help would be means of irrigation to counteract the effects of drought, provision which we fear will only excite a grim smile in England, after the series of wet seasons which have ruined successive crops.

Premising that we do not think M. Ville recognizes so correctly as Mr. Lawes does the lasting effects of cattle manure, there is no resisting the conclusions to be drawn from the experiment he adduces: one half of a piece of ground was manured with 32 tons of farm-yard manure per acre and the other with about half a ton of chemical manure per acre. With the farm manure about 14 bushels of wheat were obtained, whereas with the chemical manure the land yielded about 36 bushels, there being a loss of £19 in the former case, and a gain of £17 in the latter. Similar results were obtained over and over again. M. Ville's work is designed to answer the questions :—"Whence are we to draw our supply of those agents which according to our present ideas are destined to become the principal lever of agriculture? What results can be obtained in practice?" Our previous articles will have shewn how far those questions have been answered. A copious and steady supply of chemical manures is of the first importance in all agriculture, if, as M. Ville asserts, "Increase in production depends less on the worker, and on the quality of the tools which he employs, than on the quantity of fertilizing materials which he has at his disposal." Humus in soil and the black matter in farm-yard manure M. Ville regards as of secondary importance, useful for rendering other substances soluble, but by no means an absolute necessity to agriculture. High farming by means of farm-yard manure gives neither security nor profit to the grower, unless carried on with industrial agriculture (he means the manufacture of sugar and alcohol from beets, and so forth) which is not often the case.

Illustrations are given of experiments which showed that normal manure produced, in addition to straw,

50½ bushels of wheat per acre. Nitrogenous manure without mineral matter, 18; without any manure, 12. Experience of a similar nature was uniform. The functions of clay, sand and humus as supports of plants are defined, and much importance is attached to clay as absorbing and giving out slowly nitrogenous and mineral matters. It resists the action of rain. Clay, therefore, if not excessive in quantity and stiff in quality, is a most valuable constituent of soils. The value of humus consists in its power of absorbing moisture, and fixing the ammonia of the soils, so as to prevent it from being carried off by the rains. It afterwards gives back this ammonia to vegetation. It helps to form carbonic dioxide which exercises a solvent power, especially on calcic phosphate and limestone. It was the result of his researches into the action of humus which led M. Ville to substitute calcic sulphate for the carbonate in the manufacture of normal manure. Cultivators in Ceylon cannot go wrong, however, if they first treat clayey soils and fallen leaves, &c., to a good dose of burnt coral, and subsequently apply superohosphate potash and nitrogenous matter. M. Ville dwells on the frequent uselessness of soil analysis, because of the failure to distinguish solvent from nonsolvent matter. His own method of growing various plants in patches of soil, remedies this defect. But as such a method is impracticable in the case of our culture, the analyst should either visit and carefully inspect *in situ* the soil he is to report on (by far the preferable plan), or the fullest possible information must be furnished when specimens of soils are sent for analysis. As a matter of much interest, however, we give M. Villes account of the process by which he uses plants as analysers of the soil. "Plants are divided into two classes. With reference to the different forms under which they assimilate nitrogen—some obtaining it from the air in the form of free nitrogen [leguminous plants, for instance.—Ed.], while others derive it from the soil in the form of ammonia and nitrates—you can appreciate the result of the distinction. Those plants which derive nitrogen from the air flourish exceedingly well in a soil which is destitute of that element, as long as they find in it the three mineral constituents of the normal manure, potash, calcic phosphate and lime. Plants which derive nitrogen from the soil become, on the contrary, etiolated and yield only a scanty crop. It follows from this that by the aid of two experiments on a small scale, we may always know if the land contains the necessary nitrogenous and mineral matter.

"If we cultivate side by side peas and wheat, or peas and beet-root, and the peas yield well whilst the wheat turns out badly, we are able to conclude unhesitatingly that the land is provided with the mineral but lacks the nitrogenous matter; on the other hand, if the wheat succeeds equally well, we may be certain that the land contains both the mineral and nitrogenous matter. Can you conceive a method which is more practical and yet at the same time simpler and more conclusive?"

We should think that maize would be the best substitute for wheat in any similar experiments in Ceylon. But we know already that the vast majority of our soils are specially deficient in phosphoric acid and lime. These, therefore, we can never go wrong in adding liberally, seeing to it, of course, that nitrogen and potash are present or that they also are supplied.

More interesting, perhaps, to us as colonists is the result of an experiment on the cultivation of sugar-canes carried on at Guadeloupe by M. de Jabrun, an old settler in that colony:—

	Tons.	Cwt.
Normal manure	23	0
Manure without lime	20	0
,, ,, potash... ...	14	0
,, ,, phosphate ...	6	0
,, ,, nitrogen ...	22	8
With no manure	1	4

M. Ville remarks, "If I add that the sugar cane obtains its nitrogen from the air [why then are ammoniacal guanos so largely used in the culture of the cane?—Ed.] you will conclude from these figures that the soil is very defective in potash and calcic phosphate." We should certainly conclude that the soil was utterly worn out. So much the more valuable is the manure if obtainable at any reasonable cost.

The debilitating effects of leaf disease on the coffee plants, and the consequent falling off in bearing power, have given so much additional interest to the question of the best and cheapest forms of fertilizers, that we need make no apology for once again referring to the work of M. Ville on artificial manures. This writer insists that the value of farm-yard manure (dry) consists in the nitrogen about 2 per cent, phosphoric acid, about 1 per cent, lime from 3 to 5 per cent, and potash from 2½ to 4 per cent, contained in it. Carbon, hydrogen and oxygen, constitute from 60 to 65 per cent of this material, and silica and sand make up from 17 to 25 per cent more. The other materials are of slight importance. M. Ville's own analysis of stable dung (undried) shewed that 1,000 parts gave no less than 800 of water, 4·16 nitrogen, 1·76 phosphoric acid, 4·92 potash and 10·46 lime. Contrast

with this superphosphate which contains, per 1,000 parts, water 160·00, phosphoric acid 160·00, lime 210·00; and also Peruvian guano, water 140·00, nitrogen 125·00, phosphoric acid 137·00, potash 16·00, and lime 120·00. We should like to quote further from the analyses of plants and manures given, but we must refrain. Our readers can see that, whatever value cattle manure possesses in bulk and solvent effects, that value must be enormously increased by the addition to it of nitrogenous and mineral matter, such as is contained in M. Ville's normal manure. If only cattle manure can be produced cheaply we are still inclined to the belief that a mixture of this substance and artificial manures well distributed in the soil is the perfection of manuring. But, if the question is between farm-yard manure and chemical manures, the case for the latter in greater yield and larger profit seems complete. Here the question of the cost of imported substances is and will be a serious one until railway facilities are extended. The evidence adduced by M. Ville in favour of the liberal use of chemical manures is simply overwhelming. We ought specially to mention however, that he is a firm believer in dividing the manures, instead of applying the whole at one time. He would, no doubt, tell a coffee planter that a moderate application once a year is better than a large supply once in two or three years. In dealing with the supply of ammonia M. Ville says large quantities could be obtained if, instead of burning coke in the open air, the operation were carried on in closed furnaces. In gasworks we suppose what he desiderates is done? M. Ville really goes the length of asserting that, no matter how poor a soil is, he can work it profitably with the aid of his normal manure of four constituents! To quote:—

"Experience shews, therefore, that the four ingredients,—nitrogenous matter, phosphate, potash and lime are the only ones that need be admitted into manures.

"For myself I have never found any natural earths in which, with the help of these four substances, it was not possible to obtain a yield *comparable to that obtained in the most favoured soils.*

"This result is possible because the poorest soils are provided with the seven mineral ingredients excluded from normal manure, whilst it is not necessary to furnish carbon, hydrogen and oxygen, as the plants receive these elements from the atmosphere."

If only, therefore, the proprietor of a piece of poor land can, at a moderate cost, obtain and apply abundance of the normal manure, he can soon place his pro-

perty on the same level as that occupied by land naturally the most fertile! M. Ville distinctly says that by use of his manure crops were raised on the worst chalky soils of Champagne and the sand of the dunes of Holland, equal to the same level as those grown in alluvial soils noted for their productiveness.

By means of plants with taproots M. Ville asserts that he is able to ascertain the constitution of the subsoil as well as the soil, and in both cases with perfect accuracy. We cannot help quoting once more :—

"The quantity of soil covering the surface one acre is represented by at least 1,600 tons, and with 176 lbs. of ammonic sulphate and 35¼ lbs. of nitrogen—that is to say, the one-hundred-thousandth part of the total weight of the soil, the crop of wheat will be increased from 13¼ to 16½ bushels per acre, and the straw from 2,640 lbs to 3,520lbs.

"With potatoes, 176 lbs. of nitrates, of which 82¾ are in the form of potassic nitrate, suffice to raise the yield from 4 tons per acre to 7 tons 4 cwt.

"If the manure contains 528 lbs. of calcic phosphate, we shall obtain 32 tons of canes stripped of leaves : but with 352lbs. of the phosphate, the result is lowered to 16 tons. What result, I ask, obtained by purely scientific means, can be compared with this, whether as regards the delicacy of the method, or the utility of the information that it yields. The great value of experimental fields, then, lies in our being able to obtain such evidence as they latter by a series of proofs."

ARTIFICIAL MANURES FOR COFFEE.

In considering the best artificial manures for coffee the constituents of sombreorum ought to help us largely, for we learnt from Mr. Tytler that this manure was based on the result of numerous analysis of *every part of the coffee tree.* Its costliness is the great objection offered to sombreorum, and possibly M. Ville's normal manure is a better combination. The question here, also, is one of cost. Results, however, must be held essentially to qualify this question of cost. Experiments ought, therefore, we submit, to be tried with M. Ville's normal manure, in its complete form, and dropping one of the substances in succession. We have already said that for such districts as Dimbula and Dikoya both nitrogen and potash could, for a while, be dispensed with. Where, as is probably the case with coffee, calcic phosphate (?) is the dominant constituent, "the economical part of the

question acquires increased importance, because the superphosphate being the least expensive of the four substances forming the normal manure, and its efficacy being in certain cases very great, a slight increase of expenditure suffices to obtain a large excess of crop. With the normal manure, No. 6 (calcic superphosphate 352 lbs.; potassic nitrate 176 lbs.; calcic sulphate 352 lbs.; M. de Jabrun of Guadeloupe) obtained 18 tons of sugarcane, stripped of leaves, per acre. With an increase of 176 lbs. of calcic superphosphate the result was raised to 38 tons, an excess of 14 tons of cane, valued at £11 4s to £12 16s, the increase of expenditure being about 12s 9d." This is very tempting, but we need not tell our readers that in the case of the coffee plant we might endanger the life of the tree by forcing it into an over-yield of fruit. Let us listen to M. Ville's advice: "First of all be sure of the dominant constituents and the proportions in which it is necessary to employ them in order to obtain the maximum of their useful effects; secondly know the proportion of the subordinate constituents which these same dominants require in order to bring out their action; and lastly, only draw conclusions from the test of experiment." Some readers may be surprised to learn that in a ton of 2,240 lb. of farmyard manure the proportions of the four fertilizing substances are so low as

Nitrogen	...	$8\frac{3}{4}$ lb.
Phosphoric acid	...	$2\frac{3}{8}$,,
Potash ...	...	8 ,,
Lime ...	...	$17\frac{1}{2}$,,

This indicates a value, according to the ruling price of chemicals, which M. Ville believes will go lower instead of higher, of 10s 6d. The grand disadvantages of farmyard manure, it will be observed, are its enormous bulk and weight, at any rate the weight (8-10ths being contributed by water) in proportion to the small amount of really fertilizing matter. In wet climates especially is the water in this manure worse than valueless. In comparison between it and chemical manures, the results in repeated trials were always in favour of the chemical manures, as to produce, while the artificial manures were also found to be more lasting. There is a most valuable appendix to M. Ville's work, No. 1 of which deals with "The chemical description of the ingredients which enter into the composition of chemical manures." We only wish we had space to quote from this most interesting paper. We can only mention that M. Ville, besides being a believer in the ultimate discovery of economical means of deriving nitrogen from the air,

holds that volcanoes in their quiescent state, when they forth nothing but vapour, ought to be utilized as sources of ammonia as much as the liquor of gas works. "Of all the products," he writes, "that contain potash, potassic nitrate is most suitable for agricultural purposes." No. 2 of the appendices contains very valuable "Practical instructions on the preservation, preparation, and employment of chemical manures." Here also, however, for which we should like to quote, we must refer to the book. No. 3 is a "Collection of the formulæ for the chemical manures most used, whether alone or in combination with farmyard manure." Every fact and every figure here given is suggestive, but we must content ourselves with brief quotations. M. Ville thus indicates the

"*Strength of the different ingredients which enter into the manufacture of chemical manures.*"

		Phosphoric acid per cent.	Symbol.
Sources of Phosphoric Acid.	Calcic superphosphate	15	PO_5
	Precipitated calcic phosphate	32	
		Potash.	
Sources of Potash	Potassic nitrate at 95 per ct.	44	KO
	do chloride at 80 ,,	.50	
	do sulphate at 80 ,,	43	
		Nitrogen.	
Sources of Nitrogen	Ammonic sulphate at 95 per cent... ...	20·30	N
	Sodic nitrate at 95 per cent.	15·72	
	Potassic nitrate at 95 ,,	13·00	
		Lime.	
Sources of Lime.	Calcic sulphate (burnt gypsum)	39	CaO

Founded on this table, directions are given for the ordering of manures, if, as is preferable, agriculturists cannot mix for themselves. Appendix No. 3 gives "Practical instructions for the establishment of experimental fields and for the interpretation of their results."

MR. HUGHES' HANDBOOK OF CEYLON SOILS AND MANURES.

Mr. Hughes' remarks on iron in soils summarily dispose of an idea propounded by Mr. W. P. Stephenson at a recent meeting of the Planters' Association of Mysore that *Hemileia vastatrix* or "red rust" was due to an excess of iron in coffee soils, and that, moreover, the iron is in a form deleterious to the coffee plant, which having taken it into its system *nolens volens*, makes use of the fungus to assist it in ridding itself of the noxious element. No doubt iron in certain forms

s deleterious, and Mr. Hughes states the proposition that generally the iron and alumina in a soil should not, united, exceed 15 to 18 per cent; but he makes an exception in favour of peroxide of iron, the source of the red colour of very fertile soils. This form of iron combines with phosphoric acid, and is valuable as a fixer of ammonia, and Mr. Hughes mentions the case of a Ceylon soil of excellent quality, though ferruginous to more than twice the extent deemed generally desirable. We need scarcely remind our readers that soils containing a good deal of iron are specially fitted for the growth of the tea plant. The value of peroxide of iron in fixing ammonia is worthy of attention; but Mr. Hughes adheres to the conviction that, as a general rule, the soils of the coffee districts, especially of the young districts, do not so much need direct applications of nitrogen or salts of potash, as their indirect application in the shape of oil-cakes (especially white castor-cake), and high class superphosphate and bones. Mr. Hughes still insists, too, on the value of lime, forked into the *surface soil.* He does not belong to the school of "Medico-Agri-Horticulturists" whose panacea for all ills is the reversal of the positions of mellow soil (down to 12 or 18 inehes from the surface), and sour, inert sub-soil: sending the one down to feed the taproots, and the other up to starve the feeding rootlets.

For the vast majority of the soils of Ceylon, Mr. Hughes recommended and still recommends, not an impossible and deleterious, if possible, bringing of the subsoil to the surface, but the improvement of the mechanical condition of the surface soil by forking lime into it *to the depth of* 12 *or* 15 *inches*, at the rate of one-fourth to one-half ton per acre, following this up with cake containing nitrogen and potash besides valuable mineral constituents, and with bones and superphosphate, at rates varying with the condition of the soil as indicated by analysis. While he recommends the digging of the soil (*not* the subsoil) he recommends drainage and, where possible, terracing for the retention of soil exposed to wash.

The following is of almost general application, only that where nitrogen is abundant the cake may be omitted:—

"If cattle manure is available, the most economical dressing will be a basket of dung and ½ lb. of slaked lime per tree; otherwise, a mixture of—

Per tree.

¼ lb. steamed bones (Leechman's).

½ lb. rape or castor poonac (finely ground).

¼ lb. high-class superphosphate, 44 per cent of soluble phosphate (Lawes').

Forking the surface and application of lime being carried on as a separate operation.

"As already frequently mentioned in my private reports, it will be found more economical to apply small dressings about every two years, than larger ones at longer intervals."

We regret that space will not permit the quotation of what Mr. Hughes says about utilizing weeds by burning, or, better by converting them into comport, care of course being taken that seeds do not germinate. This is a subject of much importance for the consideration of the planters.

The section on the constituents of the fruit and leaves of the coffee bush is most interesting and important, shewing clearly how greatly the loss of leaves exhausts a tree, but we must endeavour at a future time to deal separately with this section. Suffice it now to say that loss of leaves exhausts a tree even more than production of fruit. Withered leaves, therefore, should be collected and treated with lime as a compost. Incidentally Mr. Hughes states :—

"From the analyses of the soils lately made, I should consider it extremely probable that when the curing operations are thoroughly mastered, Ceylon tea will be distinguished for its fine flavour."

With one more extract we, for the present, conclude our notice of this valuable work :—

"As a suitable manure to stimulate the tree suffering from the Hemileia a mixture of white castor cake, steamed bones, and superphosphate in equal parts and about $\frac{3}{4}$ lb. of the mixture per tree will be found generally an economical dressing, or 10 lbs. of cattle dung and $\frac{1}{4}$ lb. of steamed bones. Fish manure of good quality applied alone will also be a suitable restorative application, as it contains both nitrogen and phosphate of lime in a form readily available as plant food. But to apply any of these profitably, an improvement in the price of coffee, as well as railway extension will be necessary.'

MR. HUGHES' ANALYSES OF COFFEE, FRUIT AND LEAVES, AND THE CONCLUSIONS THEY LEAD TO AS REGARDS QUANTITY AND QUALITY OF MANURE.

Even if not so utilized, not much is lost, for Mr. Hughes pronounces pulp to be far inferior to cattle d ng, which, as our readers are aware, consists of a small proportion of valuable ingredients mixed with 80 per cent of water. But the parchment skin goes

to Colombo and is there used as a non-conducting substance for packing ice, but more generally as fuel for the furnaces of the steam machinery in the curing establishments. Unless in the shape of ashes added to composts this parchment skin never finds its way back to the estate. Its importance in quantity may be estimated from the fact, that, with all the drying that can be given on estates, the proportion parchment skin to clean coffee sent down by railway is, *in bulk*, so large that it takes five bushels of parchment coffee to give 1 cwt of clean bean. Better results are occasionally obtained, 4¾ bushels or even 4½ yielding 1 cwt; but the *average* is as stated; 60 bushels parchment coffee brought down by railway are equivalent to 12 cwt. of clean beans. The parchment skin, when divested of water, is a light substance when compared with coffee, and we have not the exact figures for its weight as compared with the bean it encircles, but our strong recollection is that 60 bushels of partially parchment coffee go to a ton on the railway. If so the parchment skin in every ton as it reaches the Colombo stores is 8 cwt. to 12 cwt. of beans, or 2-5ths of the whole. If, therefore, we were able (we wish we were) to export 1,200,000 cwts of clean coffee, that would mean the removal from the estates of 2,000,000 cwts of matter, in the shape of beans and parchment including moisture. We wish Mr. Hughes had given us the analysis of the parchment skin separately, as he has done in the case of the pulp. Besides most of the moisture being in the parchment skin it seems obvious from its appearance (it is called "chaff" at the curing mills) that it is largely siliceous in composition and does not, therefore, weight for weight, deprive the soil of anything like the quantity of valuable mineral matter that the beans do. What Mr. Hughes' analysis enables us to institute is a comparison between the constituents of 100 parts of parchment skin and bean combined ("parchment coffee") and those of 100 parts of clean beans. To enable us to institute this comparison, let us first quote the result of analysis of the ash of plantation Ceylon coffee beans (not by Mr. Hughes). The figures are:—

Potash	55·1
Lime	4·1
Magnesia	8·9
Oxide of iron	0·45
Sulphuric acid	3·6
Phosphoric acid	10·3
Chlorine	1·0
Carbonic acid	17·5

The "Dominant element" indicated by the above is certainly potash; carbonic acid (of no consequence, however) coming second; phosphoric acid third with 10·3 per cent against 55·1 of potash. Magnesia and lime both show well, as does sulphuric acid; but oxide of iron and chlorine are of little account. If we went by this analysis alone we should use a manure consisting of one-half at least of potash; the remaining half being made up mainly of calcic phosphate of magnesian lime in addition to nitrogen. Turn we now to Mr. Hughes' analysis of beans and parchment skin combined. Its history, as given by the chemist himself, is as follows:—

"The following is an analysis of parchment coffee which was obtained from some cherries sent me from the district of Badulla. The amount of moisture present is possibly high as compared with average estate coffee received in Colombo, but on this point future analyses must decide. The sample was very carefully prepared, the beans being separated from the pulp, allowed to remain in contact with water the necessary time, well washed in fresh water, afterwards dried by exposure to the sun, and the enclosed in a well-corked bottle and shipped with the samples of soil. The analysis is only a partial one as regards the proportions of the different organic constituents. Sugar, albumen, tannin, caffeine, cellulose, mucilage, &c., are included under one heading. The separate determination of each would be of interest in comparing different qualities and varieties of coffee, but is not necessary for our present purpose. The quantity of nitrogen contained in the total organic portion has, however, been very carefully determined, as well as the respective quantities of the important mineral constituents. The analysis has been made with a view of ascertaining to what extent coffee exhausts the soil.

COMPOSITION OF PARCHMENT COFFEE FROM BADULLA.

Water	13·31
Fat	10·79
*Gum, Sugar, Tannin, Albumen, Caffeine, Woody Fibre, &c.	72·42
†Mineral Matters (Ash)	3·30
	10,000
*Containing Nitrogen	1·47
†Consisting of—	
Potash	1·349
Soda	·065
Lime	·193
Magnesia	·219

Phosphoric Acid...	·260
Sulphuric Acid	·076
Carbonic Acid	·921
Chlorine	·028
Silica	·094
Oxide of Iron	·095
	3·300

"It will be noticed that there is nearly 11 per cent. of fat and 1½ per cent. of nitrogen present in every 100 parts by weight of this parchment coffee; also that in the ash constituents potash stands out very prominently and that phosphoric acid exists in larger quantity than either lime or magnesia."

Mr. Hughes' analysis gives the proportion of nitrogen which is absent from the analysis of the ashes, already quoted. The proportion of ashes in Mr. Hughes' specimen was 3·30 out of 100 parts, of nearly 3⅓ per cent mineral matter. Of this mineral matter again, over 1⅓ was potash, or more than one-half of the whole instead of more than one-half in the analysis of clean beans. Of the remainder, carbonic acid, phosphoric acid magnesia, and lime, occupy much the same relative position as in the old analysis of beans. The result of the addition of the parchment skin seems to be mainly to reduce the proportion of potash, but silicd is not present in the quantity we should have expected as a consequence. Then follows analysis of healthy coffee leaves, regarding which Mr. Hughes writes:—

"It will be noticed that the nitrogen in these partially-dried (sun-dried) coffee leaves amounts to 2·679 per cent. while the seed (commonly called bean) only contains 1·470 per cent. Also that the leaves contain 2·078 potash and ·352 phosphoric acid as against 1·342 potash and ·260 phosphoric acid contained in the parchment coffee. Hence if equal weights are taken in each case, sun-dried leaves are more exhausting in the important elements than ordinary parchment coffee. Consequently it follows that exposure to wind tends to exhaust the productive powers of an estate in a very serious degree; a fact which practical planters fully recognise."

Of course if exposure to wind exhausts an estate, much more does leaf disease, and much more do the two combined. We ought, therefore, to top low and provide shelter on "blown" places, and use the lime and sulphur remedy against leaf disease' there and everywhere. Mr Hughes gives figures for the weight of healthy and diseased leaves, shewing that 10 diseased leaves, in one case, weighed only 204 grains against 275 for 10 healthy specimens. If a coffee tree

loses 200 leaves per annum (2,000 have actually been calculated), that would be, for an acre of 1,200 trees, 247 lb. It is interesting to learn from Mr. Hughes that :—

"Again in the analysis of coffee pulp we found that 100 parts by weight of ripe cherries yielded 57·83 parts of beans (with mucilage attached) and 38·98 parts of pulp, allowing 3·19 parts for water lost during stripping.

"Further, I find by experiment that the above weight of fresh damp beans, when properly washed and afterwards sun-dried, gave 35·87 parts by weight of ordinary parchment coffee as prepared on the estate. Consequently 100 lb. of ripe cherries may be fairly taken to represent in round numbers 36 lb. of parchment, 39 lb. of pulp (natural state), and 25 lb. of water (with the saccharine mucilaginous coating originally attached to the bean)."

Assuming the average yield of coffee per acre to be 7 cwt. (784 lb.) of parchment, we should have 849 lb. of pulp.

With this estimate of a really good crop, according to present circumstances we may proceed to ascertain, with the aid of the analysis already furnished, what are the proportions of the important elements removed respectively by the seed. pulp, and leaf.

CONSTITUENTS REMOVED PER ACRE BY AN AVERAGE CROP OF COFFEE, ASSUMING 7 CWT. OF PARCHMENT FROM 1,200 TREES.

	Seed.	Pulp.	Leaf.*	Total.
	7 cwt. Parchment.	Fresh Pulp	Partially dried. 240000 leaves	Wght.
	lb. =784	lb. =849	lb. =247	lb. =1880
Water...	104·3	664·8	24·0	793·1
†Organic Matters	653·8	168·7	204·2	1026·7
Mineral (Ash) Matters ...	25·9	15·5	18·8	60·2
lb.	784·0	849·0	247·0	1880·0
†Containing Nitrogen ...	11·5	2·8	6·6	20·9

* Probably 200 leaves for each tree is much too low an average, but the necessary connection can easily be made for large trees having 1,000 to 2,000 leaves.

	Seed.	Pulp.	Leaf.	Total.
	7 cwt, Parchment. lb. —784	Fresh Pulp lb. —849	Partially dried. 24000. leaves lb. —247	Wght. lb.
The Ash Consists of—				
Potash	10·6	7·5	5·2	23·3
Soda	·5	·3	1·2	2·0
Lime	1·5	1·5	4·2	7·2
Magnesia	1·7	·3	2·3	4·3
Phosporic Acid	2·1	·7	·9	3·7
Sulphuric Acid	·6	·5	·6	1·7
Chlorine	·2	·4	·2	·8
Oxides of Iron	·7	·2	·2	1·1
Silica	·7	·6	1·6	2·9
Carbonic Acid	7·3	3·5	2·4	13·2
lb.	25·9	15·5	18·8	60·2

It will be seen that 60·2 lb of the ash of beans, pulp and leaves, consisted of 23·3, or considerably more than one-third of the whole of potash, with 3·7 only of phosphoric acid or 1 to 7 of potash; lime ranging so high as 7·2 and magnesia at 4·3. Phosphoric acid is low in pulp and leaves, but lime is high in both. Mr. Hughes states that the nitrogen removed from an acre by a crop of 7 cwt. of coffee would be 21 lb. which could be supplied by 300 lb. or ¼ lb. per tree of white castor cake. M. Ville would differ from Mr. Hughes in saying that "practically, therefore, at least the full amount of nitrogen removed should be returned." M. Ville considers one-half of this substance sufficient, even in Europe, and, if the principle is true, less than one-half ought to suffice in this country of tropical rain. It is better, however, to err on the safe side. White castor cake contains most nitrogen in proportion to bulk and weight of nitrogenous substances available, and so its use will save carriage. We really come back to the old formula of castor cake and bones, or better still castor cake, and superphosphate, although probably a mixture of steamed bones and superphosphate would be preferable and more economical. Of course, if sufficient cattle manure is available, the castor cake can be dispensed with. In that case, the bones *or* superphos-

phate or the bones *and* superphosphate can be added to the cowdung. But what, all this time, about potash, the dominant ingredient in all analyses of coffee? Let us hear what the modern chemist says, not only to correct our popular ideas, but also the theory of the great Liebig :—

"Potash is by far the largest item, there being 23½ lbs. out of 60 lbs of total ash, and if the mineral theory of Liebig was to be followed, we should make it the most important element in all coffee manures, but I need not mention that this theory has been found to be inconsistent with practical experience, indeed its fallacy is now generally admitted, though agriculturists must always feel grateful to the great German chemist for having directed attention to the composition of the ash of plants, and so opened up a field for future scientific investigation into the general composition of the organic as well as mineral constituents of farm crops.

"There are three important reasons why potash should not be supplied in large quantities in coffee manures.

"1st.—All potash salts, whether as nitrate, muriate, carbonate or sulphate, are readily soluble in cold water, and are therefore liable to be washed away before they can be assimilated by the roots of the tree.

"2nd.—Plants appear to possess the power of abstracting potash from the soil itself to a much greater extent than they do the other important mineral elements.

"Thus an average crop of turnips, 17 tons per acre, remove in the roots and leaf about 150 lbs, of potash, 74 lbs of lime, 50 lbs of sulphuric acid, and 53 lbs of phosphoric acid, and yet the manures used do not contain any appreciable quantity of potash, but consist almost entirely of phosphate and sulphate of lime in a condition readily soluable in water. I am referring now to the artificial manufactured manures prepared in thousands of tons every year, and which, under the name of superphosphate and dissolved bones, are the recognised fertilizers for turnips and swedes. Indeed every district in England now has its own sulphuric acid and manure manufactory.

"3rd.—From my analysis of the insoluble silicates (see Badulla and Haputale analysis) of good coffee soils, there appears to be a practically inexhaustible supply of potash, which will be rendered available for plant food, as the soil becomes disintegrated or decomposed by atmospheric influences.

"For the above reasons, then, it will be desirable that potash salts when applied to coffee in Ceylon should be employed in but small quantities, and should

be always mixed with some more bulky manure. I should consider 4 four per cent of potash the utmost that a good coffee manure intended for Ceylon should contain. On most estates it is not potash that is required by the soil, but a cheap source of bulky nitrogenous manure (cattle dung, composts of pulp with cake), and a moderate supply of phosphate and sulphate of lime."

We quite agree with Mr. Hughes in saying that weeds ought to be utilized as manure by being treated with lime. Plenty of lime being available, we hold that one of the best modes of utilizing fallen leaves, prunings and handlings, as well as weeds, would be the system adopted for instance on Kandenewera plantation, Elkaduwa, that of sweeping them round the roots of the trees. The weeders, who at first objected to this plan, now feel the advantages of it, and the benefit to the trees, the roots of which never stand above ground as is so generally the case on old estates, is obvious. With fast-growing "Eucalypti" and other trees available, we hold that Mr. Hughes took too despondent a view of the possibility of combating the effects of wind, while as regards wash its destructive effects can be largely obviated by a system of deep drains, paths sloping inwards to the bank with openings at proper intervals for the escape downwards of the accumulated rain water, and such terracing as is possible from the presence of suitable materials and at a reasonable expenditure. Much, too, might be done in the direction of "hedges" say of tea plants, along the underside of drains, and also running across the faces of steep slopes, so as to intercept and hold washed-down soil. On an estate in which we are personally interested the drains have been largely lined with tea plants, and when plenty of seed is available, the scheme long contemplated, of closely planted (one foot apart) hedges of the same plant, will certainly be adopted. The soil caught by such hedges can be subsequently placed round the coffee or other trees cultivated. Already some of the benefits of the hedge system are attained by the planting of tea and cinchonas so closely as 3 × 3, while the now common practice of planting cinchonas amongst coffee will ultimately do much to obviate wash. A letter by Colonel Money (author of the Prize Essay on Tea Cultivation) in the *Indian Tea Gazette* speaks with approval of a mode of cultivation adopted on a tea estate in Java, the property of a Mr. Hobhouse, and which is thus described:—

"The plants are put in 4 × 2,—four feet of course between the rows, and two feet between the plants. Each

line is therefore a continuous tea hedge. In the extract given above it is recommended to place the lines "diagonally across the hill, so that the slope along the lines shall be a moderate one," but they do not follow out this plan in Java. They run the lines there right across the slope of the hill. I believe the diagonal plan is the better, but the measures they take to prevent the wash do away with the objection.

"Between the lines, 4 feet apart from centre to centre, holes are dug two feet long, one foot wide, and 15 inches deep. In the spaces or rows above and below, the said holes are opposite the sound portions. Do you understand ? Every third row has the holes opposite the first : those of the second and fourth likewise agree. Thus, whatever wash there is must be caught by the holes, if not in the row where it accumulates, in the second, and necessarily no injury from the wash can take place. The earth taken out of the said holes is piled up, loose, between the holes.

"As an extra precaution (because with heavy rain the holes fill and overflow), catch-water drains are dug diagonally across the hill, 30 or 40 yards apart.

"Twice a year the holes are filled up, and new holes are made in the in the intervenning spaces, so that virtually the whole of the soil between the tea hedges is stirred and opened out twice a year. The same thing is done, where the land is flat, or nearly so; only there, as there can be no wash, the catch-water drains are omitted.

"The advantages claimed for the plan are threefold. First : no injury from wash can take place, inasmuch as the soil is not washed down the hill and the roots of the plants thereby laid bare. Secondly : the manure supplied is kept on or near the spot where it is laid, and sinking with the water into the holes, is brought into connection with the roots of the bushes. Thirdly : the whole of the soil, to the unusual depth of 18 inches, being twice a year, exposed to the action of the sun and air is a most efficient mode of cultivation,—may be styled, indeed, 'air manuring,' and tends to heavy flushes

"The plan, as described, is followed out exactly as detailed by the largest, and *on dit* the best tea planter in Java. He has, in his several gardens, about 1,000 acres under tea ; and if "the tree is known by its fruit," the *modus operandi*, to be judged of by its result, we must conclude his system is a good one. From his 1,000 acres he manufactures and sends to the London market, in round numbers, eighty thousand pounds of tea : ten maunds tea per acre,—a result not yet achieved in India ?

"In the above is fact, and I have no reason to doubt it (for the information has been supplied to me by a relative who has been staying with him the said relative having tea of his own in India, and having for his own sake looked closely into the matter), it is certainly woth the while of Indian planters, at all events, to test the plan on a small area, and judge for themselves.

"The system is however not a new one,—at least to me. I remember years ago, when I first went into tea in Kumaon, precisely the same thing was done on a plantation there, named, if I remember right, the 'Lohba Garden,' owned by a Captain Cumberland, since dead. I had a sloping garden in those days, and I did not adopt it. Perhaps I was wrong. Any how, it would be interesting to know if the practice has been continued at 'Lohba' (I believe the garden exists still,) and what are the results. It is in this way, hearing what all have to say, we may all learn. The produce per acre at Lohba I forget, but the teas I remember were very good.

"I have never thought 10 maunds per acre as at all impossible. It has already, I know, been done on parts of gardens in India, but on the whole of a large garden, never yet. I hope to accomplish in on the gardens, I work, as they are in a favourable tea locality, but they are young yet. This, merely to show that to my mind there is nothing improbable in ten maunds to the acre, off even one thousand acres.

"I hear the said Java planter manures liberally also; but that he does not believe in chemical manures, for he holds their effect is not lasting, but uses animal manure and vegetable manure, weeds, &c., &c., alone. To manure, doubtless, he owes a part of his success."

They have one advantage in Java we have not in India. They can, and do pick there all the year round and of course to this also, in a measure, is due the large yield mentioned. They being able to do this is due of course to the Java climate,—no cold weather to speak of I suppose. Still, I had thought the tea plant required a period of rest, to hybernate ; is not that the word ? But I suppose I was wrong.

"One or two more words as to the Java system in other respects.

"The weeds are all pulled up by the hand, and thrown into the nearest holes, where they lie and rot, and are eventually buried when the hole is filled up.

"The tea plants are pruned and kept very low never

allowed to exceed two feet in height. This is as all your readers know, considerably less in height than we allow the bushes to attain in India.

"Every 40 days they pick what they call a 'Big Flush,' but even that they only take the bud and the two leaves below it. Twenty days after each big flush they take what they designate a 'Small Flush' and at this time they only pick the top leaves of any shoots which, from their small size, had escaped when the big flush was taken.

"Thus, in the year, nine large and nine small flushes are picked—18 flushes in all.

"Like the Indian planter, his Java brother calculates four pounds of green leaf make pound of tea.

"This finishes my description, but I will add a few words as to the peculiarities and merits of the systems set out above.

"Why is the liquor of all Java teas undeniably weak? Of course I cannot answer this query. It may be due to faulty manufacture (though they certainly excel wonderfully in 'make'); or, can it be due to the fact that the trees are picked all the year round—get no resting period? Ask for opinions on this head from your readers, if perchance, any of them have Java experience.

"In India, in forcing tea climates, I have known 28 to 30 flushes per annum, against the Java 18. In India we generally take more than 'the bud and two leaves,' and anyhow we take at least this every flush. So much would argue a smaller produce per acre than is usual in India, and the one fact which would argue a larger, viz., that they pick the whole year, is neutralised when we consider the total number of flushes,—in their case 18 in 12 months; in ours, above 25 in nine months!

"To what then is their large produce due? I cannot doubt,—I never did doubt,—that even on flat land the whole cultivation system, as described, must be very efficient, and tend to large produce. The question is, how far labour for it would be available for us in India; and secondly, how far the increased produce woold pay for the increased cost of labour? Anyhow, as I said before, it is a thing to be tried. I shall try it on a small area of each of the gardens I work next year; and I advise your readers to do the same. If several do so, and all make known to you our experience, we shall arrive at trustworthy conclusions.

"But the Java facts puzzle me. If the large produce is due to improved cultivation (whether heavy and special manuring the hole system, or whatever may

be comprised therein) how it is that the flushes are not more frequent? In other words, how is it that from 18 flushes they get nearly double as much tea as we do, as a rule, in India from 25 and upwards? Can it be due to the hedge system of planting adopted, and the consequently larger number of plants in an acre? Four × four (perhaps the most general mode in India) gives 2,722 plants, and four × two (the Java system) would give just double, viz., 5,444 bushes. I have always looked with favour on the hedge system, though never bold enough to adopt it. There is much to be said for and against it (more than I have room to say here, for it would be enough for a whole letter: I will say it all ere long), but I think, the 'for' preponderates.

As, supposing the facts correct, and that from 18 flushes they get more than we do from say 25, notwithstanding a lighter system pf picking, (to which latter the Java tea bears evidence) it is plain that each plant of their larger number, must, at each flush give as much, if not more, leaf than the fewer plants we have to pick. Now, the leaf producing *area* of plants two feet apart in the lines, cannot be so large as that of plants four feet apart. In other words, each bush is smaller. The equal, if not larger produce, then, from each individual plant *must* be due to its flinging out a larger number of shoots on each square foot of the leaf producing area, and this I hold *can* only be caused by the stimulus the bush has received from high cultivation of one kind or other.

"Still, as I said, I am puzzled; for high cultivation produces frequent flushes, and this they lack in Java.

"I may learn more later, and if I do you shall have it. In the meantime I invite, and hope you will, discuss.

"I think it better while the subject, owing to my last letter, is fresh in your readers' minds, to discuss the advisability of 'Tea Hedges,'—that is, of tea planted two feet apart in the lines,—which system, as I explained and dilated on in my last communication, is followed out in Java.

"In no work on tea that I have seen is this point fully gone into. I give you here an extract, however which refers more or less to it. I quite agree with the opinions here expressed:—

"'Four feet is, I think, the best distance between the line.*

"'It gives space enough for air to cultivate, and

* I think 4½ feet on flat land.—E. M.

to pass along, even when the trees are full grown.

" 'Where manure is obtainable, and the soil can be kept up to a rich state by yearly applications a garden can scarcely be planted too close.

" 'I see no objection to trees touching each other in the lines, and advise therefore, 3 or 3½ feet there, —the former where the soil can be periodically manured.

" 'On considerable slopes, to prevent the wash of soil the plants should be placed as close as possible,—say 3½ between, and 2 feet in, the lines.

" 'A closely planted garden will grow less weeds than a widely planted one, and will consequently be cheaper to work.

" 'As the expenditure on a garden is in direct proportion to the area, and the yield in direct proportion to the number of plants, (always supposing there is power enough in the soil to support them), it follows that a closely planted garden " must " be very much more profitable than the reverse.'

"I have often in India discussed the subject of 'Hedge Planting' (that is of plants placed so close together in the line that they will form a continuous hedge, like a quickest hedge) with other planters. All such discussions have been thoretical, for on no plantation in India have I seen the plan carried out. I have always been in favour of the system, though I admit I have never been bold enough to reduce it to practice. Now, however, after the figures as to produce in Java given you in my last, I taink it very necessary to say what I can about it, and invite the opinion of others.

" The objection against the plan advanced by its opponents are: 1.—The bushes so close together in the lines (say two feet apart) have not room to develop, and consequently ' cannot ' give as much leaf as plants further apart. 2.—That the tea shrub requires sun and air, and that, placed thus close to each other, they only get this on ' two ' sides. 3.—That the roots run into each other, and occupy the same soil, and thus each individual plant only receives a moiety of the nurishment is is entitled to. 4.—That the leaf picking area of each bush is diminished; for joining each other as they do only two sides and the top are available. I know of no objections, besides these, which can be advanced against the system.

" Were the object to produce the largest quantity of leaf *per plant*, the above objections would all be sound, and fatal to the system under discussion. But it is *not* so. The result sought is the largest quantity of leaf obtainable if per any *given area*, say

per acre: so let us see, now, if what is set out above is really a hindrance to this.

"*Objection* 1. Admitted that plants thus close cannot develop as well as they would if further apart. But the smaller plants, on any given area, *may*, nevertheless, give more leaf for that area.

"*Objections* 2 and 3. Same may be said in reply to these. The bushes *will* be smaller, but the leaf per area *may* be more.

"*Objection* 4. I incline to the belief that, as the plant is prevented sending out new shoots on two sides, it will give birth on the other two sides and top (available) to all the new shoots the constitution of the bush inclines it to produce. In other words, the shoots which would otherwise have been developed on the *four* sides and the top, will in this case be all produced on the top and *two* sides. Further, in answer to the objection that the leaf producing area is smaller, I admit of course it is so per plant, but the continuous wall-like two sides, and the continuous table-like top, produced by the Hedge system, would give, I think, a really larger leaf-producing surface per acre.

"That each plant, owing to its proximity to others, cannot be cultivated all round, that is, that the soil cannot be opened out and stirred all round, is another argument against the plan of hedge planting. It is, however, only partially true. Though the soil cannot be *dug* between the plants in the lines, it can be more or less *stirred* with weeding hand-forks, while the absence of weeds between the plants in the lines, due to the complete shade, makes cultivation less necessary.

"I also believe that, in the hedge system, the larger number of roots and rootlets would be thrown out by each plant on the two free sides, and consequently the nourishment would principally be drawn from the soil. which could be thoroughly cultivated.

"All the above pros and cons apply both to flat and sloping land, but in the latter the resistance the bushes, thus closely planted, give to "the wash" is an extra advantage."

We have given these long extracts in full, because the climates of Ceylon and Java are so much alike, that what applies to the island of Indian Archipelago must be largely true of our own Indian island. Our readers are aware that the complaint regarding Ceylon teas, equally with Java ones, is want of strength, and it will be of interest and importance to know if absence of a pronounced winter is, as Col. Money surmises, the cause. Because, if so, measures may be possible which will counteract the disadvantage, a disadvant-

age which, it is obvious, will less attach to estates at a very high elevation than to those lower down. The Java scheme of catchment and renovation holes is, as Col. Money correctly points out, not new. A diagram which the printers can easily manage to represent will make the system clearer:—

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If the ubiquitous scribe, who finds "my scheme" in every possible form of "agri-horticulture" proposed, claims this also, then we at once say, that the gentleman in Java makes holes to deposit weeds in and to catch soil. It has never occurred to him to place the trees themselves in water holes, or to encompass them with walls of circumvallation so as to ensure wet feet. Besides which, the question of cost and benefit in proportion to that cost are, as stated by Col. Money, questions for consideration. We know that many planters in Ceylon object to weed holes on estates, that, in very heavy rain-storms, the weeds and their seeds are washed out and spread by the overflowing water. But, the holes aside, we submit the hedge system as a good and in many cases the only possible mode of terracing. A better plant than tea might, perhaps, be adopted on coffee plantations, but in the case of tea estates there is the advantage of having one homogeneous product. Our own idea is that, on very elevated estates, the plan of planting 3 × 3, and having hedges of bushes only one foot apart at intervals across the faces of steeps, is preferable. But the Java scheme makes every cross-row a hedge or terrace. On an estate in the Darjiling district we saw tea planted, the rows 3 feet apart with the bushes only 1 foot apart in the rows. Our companion on the occasion, Mr. Gammie, objected that the roots would crowd each other. On the other hand, we may repeat that on the celebrated Datoorieh estate, the property of Colonel Fyers and Dr. Brougham, we were told the very largest return of tea for area was obtained from trees which had been allowed to grow up in a nursery. The bushes, packed closely together, were pigmies, compared to old trees which

had been planted 8×8; but, as we have said, the returns of tea from the closely-planted bushes exceeded that from any equal area on the property. We have, therefore, reason for advocating close planting in the case of tea, while in that of cinchonas, especially *C. officinalis*, close planting provides for casualties at all ages. With plenty of gum-trees, cinchonas and tea bushes, coffee estates could be scored with rows which would act both as terraces and breakwinds combined. We are speaking now, of course, of high and exposed estates, so numerous in Ceylon. Holes and catchwater drains are, no doubt, useful expedients on steep sloping lands, but they are costly and difficult of upkeep. Whether they are adopted or not, we feel safe in recommending far closer planting of tea to a lesser extent of coffee, than on comparatively level land, land which, by the way, is not the most suitable for cinchonas. But it is not merely flat land or very exposed land on which *they* fail. On certain portions of a hill-side they will flourish: in other parts large patches refuse to grow or gradually die off. Wash, wind and soil are no doubt each responsible, but we seem to have yet a good deal to learn regarding the fever-trees and their likes and dislikes. That the Java tea planter should prefer cattle dung and rotted weeds to artificial manures, shews how unsettled opinions are, or rather how largely they are influenced by local circumstances. As regards the low topping of the Java trees, we suspect this fact and the smallness of the beautifully curled tea leaves which we have seen and admired, without admiring the taste of the "liquor," are explained by the other fact that the "jât" cultivated in Java is pure China. The digression regarding tea cultivation, though perfectly germane to the subject of our article, for most of the principles which apply to the one cultivation apply also to the other, has so lengthened our remarks that we must defer the discussion of Mr. Hughes' analyses of coffee fruit and leaves and the results they point to, for another occasion.

THE ENEMIES OF COFFEE :—WHITE GRUB.

(*From letters and articles in the "Ceylon Observer."*)

A local planter, who is the last man to look only at one side of a picture, told me that ten years ago when entering on the coffee enterprise he estimated a return of 6 cwts. per acre *at least*, after making allowance for all possible adverse contingencies! He could not fortell the appearance and disastrous influence of white grubs

and the leaf fungus ; but neither did he anticipate the largely compensating increase of prices which has taken place. But for this, where should we be ? In my own case, having " done my duty by the land " in the shape of forking, liming and manuring, my return for the season now closing will be somewhat less than what I got three years ago from a bearing acreage less, probably, by one-fourth. I am comforted by being again told to look out for the grand results of "next year," the show of bearing wood being all that could be wished. As my experience is only too general, it is interesting to trace, if possible, the exact cause. My inclination is to say " Mainly the weakening influence of *hemileia vastatrix.*" It appeared on the plants in my first nursery in 1872 and blackened off the ends of the primaries of my finest plants in 1874 and 1875. Since then it has only occasionally displayed itself obviously to the outward senses, but it has been "all there " all the time at its vampire-like work. Passing by a most destructive visitation of rats, in which whole primaries and whole plants were cut down as with a sharp knife, I may say that grubs have only recently reached me, and I cannot join some neighbours in violating chronology as well as science by asserting that grub is the cause of leaf disease ! Tenterden steeple and Goodwin Sands are surely more intimately connected. It would, in my opinion, be as scientifically logical to say that the leaf fungus had by a process of evolution generated grubs,—the worthy progeny of the cursed (*cursory* remarks must really be excused) cockchafers. Consulting "experienced and intelligent planters" has the same effect as going out into the smoke which is drifting down from the patanas. I heard the groans with which the Dimbula planters greeted Mr. Cantlay's plea for the grubs :—" Did ever any gentleman see a grub with a coffee root in its mouth ?" The question was literally yelled down. But lo ! here comes Friend Dixon laden with Science and armed with an all-revealing microscope, and he pronounces the cockchafer's grub to be as much a friend to the planters as he desires to be himself ! His theory was stated to me in the keen cold of this morning, and I repeated it subsequently in the blazing sunlight to a planter who was guiding and encouraging some scores of coolies in cutting a road through my best coffee and my finest seed-bearing tea bushes and cinchonas. He took up a coffee-root from which a mamoty had scraped off the bark, and he said, in answer to my question as to the inability of coffee bushes to ripen their crop, "The main cause," he said, " is certainly grub ; for I have taken up trees which were destitute of feeding rootlets and the large roots of which were bare like that,"

pointing to the scraped coffee root. "Ah!" was our response, "your illustration would be accepted by Mr. Dixon as a strong support to his theory, which is that the real enemy of the planters is a fungus which destroys the feeding rootlets, and also barks the woody roots, while the grub comes as the planters' friend to feed on the fungus." I told the tale of Mr. Dixon's theory as it was told to me, but (holding myself open to conviction) with no more inclination fully to accept it than the opposite theory that grub is responsible not only for the destruction of the feeding rootlets, but for the loss of the leaves, on the cellular tissues (the very life-blood of the coffee-plant) of which *hemileia vastatrix* feeds. Does Mr. Dixon mean to affirm, that he has found a destructive fungus on *every* uprooted tree which his planter-friends supposed to have suffered simply from grubs? and does he deny that the progeny of the cockchafer feeds on healthy living tissues? Going on my own experience of the termites which build their nests in cinnamon bushes in Colombo without ever injuring the living branches (devouring only dead or dying matter), I could not understand the stress laid by Indian tea-planters on the removal of all dead timber from their land, lest the "white-ants" migrate from the dead timber trees to feed on the living tea-bushes. What my experience led me to doubt, I was compelled to believe on the universal testimony of the tea-planters, who affirm that white-ants *will* attack and destroy perfectly healthy living tea-plants. There is also the case of the phylloxera and the vine, and the worse one of the grasshoppers in America, who, after eating the plants of a tobacco field, arrange themselves on the fences and squirt tobacco juice at the unfortunate farmer! I do not doubt the prevalence of and the mischief occasioned by subterranean fungi, but surely the growth of such vegetation is not copious enough to supply food to the *millions* of grubs which are found in the soil round "shuck" coffee trees? My inclination, as at present informed, is to believe, that leaf disease takes priority of grub both in time and power for mischief. There were grubs before the era of leaf disease, no doubt, as there were generals before Agamemnon. But the creatures were few and far between and were mischievous only on isolated spots. They did not in the days of old sweep over whole valleys as they have done from the mouth of the Nanuoya in Dimbula to the topmost cultivation in this district. If we are to say that the one pest predisposes to the others, then I think we are rather justified in saying that the debilitating influence of leaf disease (added to abnormal seasons) has encouraged attacks of grubs and root fungi, than in stating the

converse of the proposition by giving the bad eminence either to root fungus or root grubs. Is it not the fact that trees are just as much "shuck" and crops as sadly short in districts where *hemileia vastatrix* ALONE is destructively and debilitatingly prevalent, as in districts, where the triad of plagues,—leaf fungus, root fungus and white grub—is rampant or at least regnant? We shall be all glad to hear what Mr. Dixon has to say as to the origin of the evil days on which the coffee bush has fallen. As Dr. Parr said of the origin of abstract evil in the universe, we may safely assume "there was no good about it." A still more important question to be answered is, "What is the remedy?" or "What are the remedies?" Almost everything has been tried (in isolated experiments), from the mineral oils of Philadelphia to the sulphur of Sicily, from the lime of the coral reef of the ocean to that of the dolomitic mountain rocks. What are we to persevere with or in what direction is the treatment to be changed? This we know, that the prominent symptom of the patient is debility, and that the prominent cause is an EXTERNAL affection. Tonics are good, but they alone are not usually supposed to be sufficient to cure irritating skin disease.

I asked planters at the Dimbula meeting if they agreed with Mr. Grigson as to the injury inflicted not only directly by the grubs but indirectly by the frequent digging rendered necessary by the presence and ravages of the insects, and they replied that they did so agree. Now if sourness of soil and the presence of fungi had been the main sources of mischief, how came frequent digging to do harm instead of good? If also the soil is permeated by fungi and has always been so permeated, how came it that estates in Dimbula, notably *Maria*, gave grand crops while fungi, *the enemies* alone, were present, but commenced a career of decadence the moment the *planter's friends* and the enemies of the fungi, viz., the grubs, made their appearance? If it is affirmed that the sourness and the presence of destructive fungi did not originally exist, but have supervened on cultivation which included drainage of the soil as well as manuring, then I can only say that my commonsense is shocked and offended, and that I refuse to believe the statement until proof irrefragable is adduced. As to deep tillage,—tillage indeed which can scarcely be called deep,—see what so shrewd and experienced a planter as Mr. James Taylor wrote to the editor of the *Indian Tea Gazette*. Mr. Taylor hoed some of his tea Indian fashion, only 15 inches deep, with the result of killing a good propor-

tion of the bushes : from the injury done to their feeding rootlets, no doubt. If we have much to learn so have our teachers. To announce an infallible panacea while condemning all that honest and intelligent men have done in the past, is surely to give occasion for the charge of empiricism. Mr. Dixon, we feel assured, is not the man so to speak. That sourness of soil and subterranean fungi are great enemies to coffee culture, we do not require proof: we have long been assured of the fact. But we can no more believe that cockchafer grubs are friends and not enemies of the coffee plant, finding their food (legions of them as there are) in such fungi as can flourish underground, than we can accept the other doctrine, held by some, that grubs and root fungi are the originators of the enormously more mischievous and deadly aerial fungus, *hemileia vastatrix*. Willing to accept all the light which scientific research can yield, we can but say that, as yet, while willing to believe that soil sourness, and underground fungi, are great evils, we hold that they are, as enemies of the coffee tree, isolated and insignificant, when compared with the grubs which feed on the roots and the external fungus which destroys the leaves of the plant. And we take our stand on the assertion that those two destructive enemies of the coffee plant have increased and multiplied, *not* because the planters of Ceylon "have hitherto followed a barbarous system unaided by the lights of scientific researches," but because of laws, for some mysterious but ultimataly wise purpose stamped on nature by its Creator. Our wisdom is to unite in fighting our common enemies, instead of indulging in mutual recriminations, or hugging the belief that "we are the men and wisdom will die with us."

THE CAMPAIGN AGAINST COCKCHAFERS AND GRUBS.

Minutes of the meeting of the sub-committee of the Maskeliya Planters' Association appointed to enquire into the best methods to adopt for the destruction of the cockchafers and their larvæ; held at the Forres bungalow, 7th January 1880. *Present*:—Messrs. R. A. Crabbe, H. G. Mackenzie, J. R. Hood, W. J. Newington, and W. Jardine. After some preliminary discussion the following were suggested as likely to be of use :—

I. Catching the beetles at night. It is pretty well known that the cockchafers are active only during the night;—where they hide away in the day-time is a

problem—they come out at night, and, after sporting about for an hour or so, settle down to feed; they are partial to the leaves of jack, plantain, and many kinds of jungle trees, but jack is their especial favorite. Where-ever trees other than coffee and cinchona are growing on an estate that has had a visitation of grub, they should be examined (after 8 p.m.), and if the beetles are found on them they should be shaken off into a large cloth spread for that purpose; this plan had been tried by one of the committee with success. It was suggested that if the beetles feed on jungle trees, as no doubt they do on some kinds, what would be the benefit of catching those that feed on the trees growing in estates, as a swarm from the jungle trees would come down and deposit their eggs in the more warm and congenial soil of the estates. This, however, is only a surmise, and should not prevent the attempt to destroy those we can; and as every female lays from 30 to 50 eggs, the gain would be immense if the hundreds of thousands of beetles that are to be found from February to April could be got rid of.

II. Water and a floating light. One of the committce said that he had hung a lighted lantern on a pole, for two nights, in the centre of a dam, and that the only catch was ten rhinceros beetles; he had also put a basin of water and a light over it, within a few yards of a tree where the cackchafers were flying about in hundreds, and and only caught five in three hours; this certainly was not encouraging and did n't pay for the candle. This plan might answer on open patanas; but it was thought not likely to succeed in the coffee.

The sense of the meeting was, however, in favour of applying some substance or substances to the ground, that by its smell or poisonous properties would be distasteful or destructive to insect life; and if of a manurial nature so much the better. Amongst others, "lime and sulphur," "gas lime," "sulphate of copper," and, as suggested by Mr. Agar, "corrosive sublimate," were mentioned as worth a trial. The distance that water would often have to be carried, and the large quantity that would have to be used, might prevent the "sulphate of copper" and "corrosive sublimate" being much used; but in favourable localities they should receive a fair trial. The Committee regret they are unable to suggest any other or more effective means, but would strongly urge upon all who can do so, the trying of one or other of these proposed remedies, as may best suit their circumstances. It was mooted by some that grub never attacked the same portions of an estate, or even the same estate two years in succession; how far this is true we know not, but if there is truth

in it, it has consolation for those already afflicted; and conveys a warning message to those yet more fortunate, not to stand idly by, but to have their eyes open, lest the enemy come upon them unawares.

WILLIAM JARDINE,
Secretary of Committee.

GRUB AND THE COFFEE TREE.

Mr. Dixon does not hold that the white grub confines itself to feeding on a fungus growing on the roots of the coffee tree, or that it abstains from attacking the rootlets themselves; but he does hold that they only attack weakly diseased trees, roots, or rootlets, which have already begun to suffer from other causes such as fungoid growths, sour soil, or bad tillage. Our correspondent "Planter" and other writers will be interested to learn that Mr. Dixon disposes of the difficulty about the "mandibles" very readily by pointing out as a scientific naturalist that the mandibles have very little to do with the feeding qualifications of the grub: they are fingers for holding, rather than teeth and jaws for grinding and masticating. A provision for the latter is made quite independently of the mandibles in the grub. We are, of course, bound to listen with respect to the results of Mr. Dixon's observations so far as they extend, chiefly in the Kotagaloya valley and along the sides of Great Western in Dimbula, and to conclude that, where he found grub in this quarter on or near to the coffee, there existed evidence to his mind of the trees suffering from other causes. We understand that he found the same grub luxuriating in old decaying forest trees and stumps, or in banks in which no coffee grow, results which he will no doubt adduce in support of his theory. But at the same time he has unquestionably a great deal of experience and observation to combat and overcome before he convinces the Ceylon planting community that the white grub does no harm to healthy well cultivated coffee trees. We have already quoted Mr. Nietner's description and remarks, and he was a planter of exceptional experience and fairly good powers of observation as well as an entomologist. We may repeat the note which he added in 1872 to the second eddition of his pamphlet on "The Enemies of Coffee Tree" to shew what he had to say from personal observation :—

"Note in 1872—Since writing my first note, I have seen a good deal of the ravages of the White Grub. On an estate in my neighbourhood a gang of coolies

was employed to dig them out of the ground (for they are always near the surface at the end of the feeding rootlets) which they did at the rate of about a quarter of a bushel per man per day ! Still that Coffee recovered. However, in other cases (on some estates in Dimbula) I have seen the coffee killed wholesale,—and magnificent old trees too. But the most glaring instance of the destructiveness of these insects that was brought under my notice was on an estate in Nillembe. The work had been going on for years, the grubs making their way from one end of the property towards the other devouring everything before them, at the rate of about eight or nine acres per annum ! Young trees and old, manured or unmanured, good soil or bad—all was the same to them. Lime, salt, carbolic acid and other remedies were tried, but without effect, I believe. Fair Coffee being worth about £40 per acre, this was rather a serious case. —The large white grub has just completely destroyed a Pine-apple bed of mine without touching a single one of the surrounding Coffee-trees."

We can only now wait for Mr. Dixon's observations and report He will no doubt have some interesting facts to bring before us. There are some very curious circumstances which have long puzzled planters about the attacks of grub. At one time it was thought proximity to patana rendered an estate liable to attacks, and certainly this has proved to be the case in several instances ; but in Maskeliya on the other hand, where many plantations have severely suffered, there are no patanas, while in the districts north of Kandy where patanas abound—the Knuckles, Kelebokka, and Rangala, for instance—white grub has scarcely ever been heard of. In Nilambe and Ramboda grub was at one time very bad, according to Nietner, but Wavendon, which Mr. J. L. Gordon reported to have been greatly affected, has survived the attacks and is one of the finest old properties in the country, It seems to us therefore that, before a conclusive report can be drawn up, the experience of the majority of districts and planters ought to be taken into account, but Mr. Dixon's observations will be valuable as a contribution even if hereafter sufficient reason to adduced for overturning his main conclusion.

WHITE GRUB.

Mr. A. C. Dixon's Observations.

There appears to have been some misunderstanding respecting my opinions of the white grub. I suppose my ideas have passed from one to another, and at length become greatly modified after the fashion of a certain

game where a sentence is whispered and passed along from one to another in quick succession.

The *larva* or grub is very different in structure and mode of life from the perfect insect. As such it grows to its full size without any notable change and without developing wings, and then passes as a *pupa* into a resting state, anchoring itself firmly by means of its mandibles during which stage the wings are developed and it takes up the adult or *imago* form.

Now what I maintain respecting this grub is as follows, and I can prove that it holds good in the district where I made my observations. The chief food of the grub is not the healthy rootlets of the coffee tree, but those rootlets after having been rendered suitable and palatable by the ravages of a fungus, the mycelia of which in many cases are visible to the eye and which permeate the tissues of the root. This fungus I have observed on making sections of the roots in various stages of its life.

Some have supposed that I said the grub lived on this fungus alone and they might well ask the question where could the grubs obtain sufficient food. After the rootlets are diseased the grubs devour the dainty morsels and leave the roots bare and polished, I do not assert that the fungus never appears without the doctor grub: in fact the grub is no doctor at all; he is rather a scavenger removing the diseased organic matter as rapidly as he is able; but when such fungi and diseased tissues are in abundance there is every inducement held out to the cockchafer to deposit its eggs, for then the offspring when hatched will be well provided for.

In reply to another gentleman, the grub may be noticed travelling downwards to the extreme rootlets, for such being the most delicate will be liable to be attacked first, the rest following in due course.

As to the cause of this fungus, I am convinced that in the districts I visited, Ythanside and estates surrounding, it is due to various circumstances, such as decaying stumps on their journey back to the place from whence they came—to sourness of soil—to stagnation giving rise to growths of low vegetable types, none more common than the liverwort, and what can be more indicative of excessive moisture and acidity?

When the grub is found around healthy trees, which one planter suggested was against my theory, I observed they were after rotting bulky manure deposited to holes and other decaying matter.

As a rule I do not believe that the larvæ of the coleoptera live on healthy tissues of plants but on those already attacked by disease. That the beetles, the organization of which is different, prey on healthy tissues is well-known. One gentleman asks why such powerful

mandibles are present on these creatures. Mandibles are often prehensile. Look, for instance, at the powerful ones of the crab and other crustaceans, and although nature has admirably adapted the organs of all creatures for their purposes, yet we have numerous organizations that are as yet a riddle to us. For example, why do many crustaceans feed on decaying food and are yet provided with hard chitinous bars in their alimentary system to masticate food.

As for the grub being a friend of the planter, I said it was so in a certain sense, and never thought for a moment that anybody would try to encourage it. Just as a watch is a useful instrument to denote time, so the grub is an index to point out to the planter that there is a something radically wrong. If such soil be attended to there will be no need to catch the cockchafers unless indeed you do it by the million as suggested and then dry them as a feeding material for stock kept here or export them as is done from Germany for the same purpose. It is well known that dried cockchafers form an excellent food material. Here is a comparison with rape cake and coconut cake, estimated by Dr. Emil Wolff of Hohenheim :—

		Coconut Cake.	Rape Cake.	Dried Cock-chafers.
Water		12·7	15·0	13·5
Ash		5·1	7·4	6·7
Organic matter		82·2	77·6	79·8
Albumenoids		23·4	30·3	55·5
Crude Fibre		14·6	13·8	13·9
Extractive matter free from Nitrogen ...		34·4	23·8	—
Fat &c.		9·8	9·5	10·9
Nourishing constituents	Albumen ...	17·1	24·2	38·0
	Carbohydrates	30·3	18·3	—
	Fat	8·1	7·7	9·1
Comparative value : coconut cake being unity		1·0	1·2	1·64

That the beetles contain a considerable proportion of phosphates there is no doubt, and we need not be surprised when we know that they feed on leaves which contain the life blood of the plant. If we could not utilize the creatures caught on the large scale as food material they might be turned to account as manure, or the grubs would do very well to feed pigs, or perhaps the beetles might be of use to extract a useful coloring matter therefrom. For any such purposes it might be well to declare war against them.

I never advocated the grub as a suitable companion for the coffee tree, but feel convinced, in spite of what

has been written or said formerly, that if on estates I observed either Colombo coral lime or dolomitic lime of the country be applied and the soil well forked the grub will assurely be diminished.

The worst of the so-called grubbed patches of coffee which I observed were not by any means the places where grub could be found in greatest abundance. I found them in larger proportion on several non-grubbed patches preying on rotting litter, decaying stumps and logs.

That the grub may be found with rootlets in its mandibles, I admit : such is the case prior to its transformation ; and with regard to grubs eating healthy coffee roots. I do not doubt it if caged along with them and no other food to be had.

It is well known that one of the breeding grounds and favourite resorts of the grub are the "patanas." Now I have not visited many of those interesting places, but on those I have seen the coffee trees on the margin seemed none the worse for their proximity. Now if the cockchafers thought that healthy rootlets were suitable food for their offspring, we should have found them there of course. I am aware that coffee adjacent to patanas in some parts has suffered, but on examination I am of opinion that there is an inducing cause.

Perhaps the soil may be very peculiar where I have made my observations, and, should I ever visit other districts, I may have occasion to modify some of my opinions, but Dimbula is not the only district I have visited and observed.

I cannot help thinking that if the rootlets of the coffee tree—the caterers of food for the maintenance of the plant—be afflicted with the fungi, that deterioration of tissues entering into its build must follow more especially in the leaves, where the food is elaborated which the rootlets have gathered. I am glad to learn that another gentleman who proposed some questions thinks that commonsense and the eyes nature has given are *all-sufficient* ; why then ask questions ? science can be no good to such a one.

I should be sorry to retard planters in carrying out any of their schemes for the suppression of grub. There is nothing like experience even although it may be very dearly bought. I quite understand its value, as I had much to do with practical agriculture in England for many years. I hope that before planters condemn or favour my opinions they will give the matter their thoughtful consideration, noting the presence of surroundings of patches attacked by grubs with regard to shelter, food, agricultural conditions, such as drainage, nature of soil, nature of manures, state of weather &c.,

and not jump at conclusions hastily as has been and is still the case with the theory of the "*incompatibles,*" sulphur and lime which can do no great good save the introduction of lime compounds to estates in a very costly manner. With respect to black grub and other noxious insects, I do not offer any opinion at present.

ALEX. C. DIXON.

THE GRUB QUESTION: A PLANTER WHO IS NO SCIENTIST ARGUES FOR NO DELAYS IN DESTROYING THE WHITE GRUB, AS THE ENEMY OF COFFEE.

In Packard's "Study of Insects," p. 454, I find this note on the subject:—"Melolontha and its allies feed exclusively on living plants." From Louis Figuier's "Insect World," pp. 438 to 450, I make the following extracts:—"For the first year the larvæ do not eat much. They feed then principally on fragments of dung and on vegetable detritus, and keep together in families. Next spring the want of a greater abundance of food forces them to disperse: they begin attacking the roots which they find within their reach. The ravages they occasion are incalculable: market gardens are sometimes entirely devastated. Fields of lucerne have been seen partially destroyed by them; meadows of great extent lose their pasturage: oat fields die off before they come to maturity."

"In proportion as they increase in age and strength, especially in their last year, do they attack also ligneous vegetation. When they have gnawed away the lateral roots of a young tree, the new roots corresponding to them dry up. The larvæ then attack the principal root, and thus bring about the death of the tree."

With these facts before him, will Mr. Dixon any longer ask us to give the matter our thoughtful consideration, though sorry to retard the carrying out of schemes for the suppression of grub?

NO DELAY.

AN OLD PLANTER ON HIS CAMPAIGN AGAINST COCKCHAFERS AND HIS REMEDY FOR GRUB.

Maskeliya, 23rd Feb. 1880.

DEAR SIR,—Coming up from the store a few evenings ago at about 6 o'clock, I was quite surprised at the number of beetles flying about in the coffee. I caught a few and found them to be the cockchafer. Thinking

that where they were so numerous they might possibly feed on the coffee, I went out after dinner and examined the coffee bushes, but could not find a single beetle. I then went up to a road lined with cinchona trees, and on looking at these saw the enemy quietly enjoying their *tonic* supper ; every tree had its share : some more and some less. Continuing my walk I went down to the site of an old set of lines where there are a few jack trees ; and these were simply swarming with beetles. On holding up the lantern I carried they dropped down in great numbers, but none were attracted to the light : in fact fire does not draw them, for some large piles of timber, that were being burnt for the ashes, were in full blaze within 20 yards of this tree, and 50 yards of two others, and the beetles did not seem to notice it ; and the men watching the fires said that none had flown about near them. This I think should prevent any person trying floating lights ; for if a bonfire won't attract them it is not likely that a little twinkling light will. Feeling convinced that there was no time to waste in trying to catch and destroy the beetles, I next day sent for 60 yards of cotton cloth : this I had made into sheets 15 feet square ; but, in order to admit of its having the tree in the centre when passed under it, the centre seam is left open for half the way down, the open ends are passed round the trunk of the tree till brought up by the fork ; they are then tied with strings, already fixed, like those attached to a pillow-case, thus making a complete surface of sheet equidistant all round the tree (if the spread of your trees is more than 15 feet, your sheets must be large, in fact to the full spread of the branches, as the beetles feed on the *outer* edges of the trees). Your sheets being spread, one cooly holds each of the four corners. A coolie gets in close to the stem, which he can do through the ties in the centre seam, and, if the tree is small, shakes it, or if too large he mounts into the branches, and shakes each one separately ; this will cause all the beetles in the tree to fall into the sheet, the corners of which if raised and shaken causes the beetles to fall towards the centre, when they can be taken up by the hand and put into a bag. The sheet is then untied and taken to the next tree, where the same process is gone through ; the whole process does not take more than five or six minutes. My first night's catch with one sheet for about five hours was 10,400 beetles, and the following night, on a neighbour's estate where I went to illustrate the method, over 9,000 were caught in two hours, and more the following night. This will give some idea of their numbers. I have tried to explain my way of catching them, and

if any one can suggest a simpler I am ready to try it. I fully agree with a neighbour who has some 300 jack trees, who proposes lopping the branches of two-thirds of them, leaving only one-third with the leaves ; he will thus concentrate the devouring armies, and be able to have all the trees shaken each night. I cannot follow those who wish to cut down all trees on the estates, giving as a reason that if the beetles have nothing to feed upon they must go somewhere else or perish. No fear of the latter, I fancy, as their tastes seem very varied. This question, as also that of the beetles feeding in the jungles and coming down to the estates to lay their eggs, requires more observation, and I won't venture an opinion upon it ; but, whether they do or do not, I intend to kill all I can ! and I wish I could persuade others to do the same. You perceive I do not enter into the question of the grubs eating the rootlets of the coffee trees : I am fully convinced that they do, both sound and unsound ; at the same time I am as fully persuaded that close draining and thorough forking of the soil with, if possible, unslaked lime applied after, is the best remedy for the grub, besides all other advantages derived by the trees from the improvement to the soil.

W. J.

NITRATE OF SODA A CURE FOR WHITE GRUB : "TRY IT."

A proprietor of plantations in Ceylon resident in the old country favours us with the following bit of experience, which he thinks may be of service to planters troubled with grub :—

I had a kitchen garden two acres in extent, and I was told that it was impossible to grow carrots in it, on account of the "wire-worm." I tried to grow them in different parts of it, but failed ; as soon as the carrots formed roots, they were perforated and of course died. I tried many remedies, such as quantities of salt, 'hot' lime from the kiln, &c., but all in vain ; at last I was compelled to grow my house carrots in the field with the other roots, such as mangolds, turnips, &c. Some years afterwards I was told that nitrate of soda would banish the wire-worm, I therefore tried on half an acre, ploughing and harrowing the ground and sowing on it by hand broad-cast three-quarters of a cwt. of the nitrate of soda. Three weeks after, I sowed the carrots in drill with manure and I had a splendid crop *not one of them touched by the wire-worm.* Nitrate of soda is a *good manure* and cost about 17s. per cwt. I believe it may be got cheaper now.

Colombo, 8th March, 1880.

SIR,—In the "Journal of the Chemical Society" for February, among the extracts from foreign journals, there are a few that should interest an agricultural community.

"Experiments on the Manuring of Barley, by P. Wagner and W. John (Bied. Centr. 1879). The soil in which these experiments were carried out was a sand containing 1½ per cent of humus, the phosphate being applied in the following experiments one day before, and the nitrogen (in the form of Chili saltpetre) the day after sowing. The following table shows the quantities of manure applied per hectare and the yield obtained." I may mention that a hectare is equal to 2·47 acres and a kilogramme to 2·2 lb.

	Corn. kilos.	Straw. kilos.
(1) Unmanured... ...	4420	3770
(2) 20 kilos nitrogen ...	5280	4890
(3) 50 kilos soluble phosphoric acid...	4570	4490
(4) 50 kilos soluble phosphoric acid with 20 kilos nitrogen...	5320	4920
(5) 50 kilos phosphoric acid in the form of freshly precipitated phosphate of lime and 20 kilos nitrogen...	5600	5110
(6) 50 kilos soluble with 43 kilos insoluble phosphoric acid in form of phosphorite with 20 kilos nitrogen...	5970	5370
(7) 35 kilos soluble and 30 kilos insoluble phosphoric acid as above, with 20 kilos nitrogen ...	5660	5350
(8) 50 kilos soluble phosphoric acid in form of phosphate of potash with 20 kilos nitrogen... ...	6170	6500

Turning to Johnstone and Cameron, we find that barley, the subject of the foregoing experiments, contains the following ash constituents per 100 parts :—

	Barley grain with husk.			Barley Straw.
Potash... ...	21·28	...	...	19·32
Lime	2·40	...	...	7·00
Phosphoric acid	33·17	...	...	4·83

Barley seed contains 1½ per cent of nitrogen.

The abstracter goes on :—"It is evident from the above experiments that although the soluble phosphoric acid yielded poor result, the use of saltpetre proved very advantageous. The reason of this may be looked for in the fact that the soil was so very poor in lime, as not

to be able to arrest the phosphoric acid during its percolation through the soil after rains, thus only a small quantity of it came into actual contact with the roots of the barley." In Ceylon soils, oxide of iron would arrest the phosphoric acid. "This of oourse was different in the cases of experiments (5) (6) and (7) where part at least of the phosphoric acid was supplied in the insoluble form, and larger yields were the result. With regard to experiment (8) the authors do not explain whether the remarkable yield obtained was the result of the way in which the phosphoric acid was combined or of the presence of potash" : the latter I should think.

"Manuring Experiments with Oats. By C. Jenssen (Bied. Centr. 1879). A field was marked off into eleven plots of 975 square metres each ; of these, two were not manured, the remaining nine being treated with quantities of manures of various sorts equal in value commercially. The table following shows the various manures used and the resulting produce :—

"Quantity applied per Hectare	Kilos.	Grains. Kilos.	Straw. Kilos.	Chaff. Kilos.
Chili Saltpetre	19	201	268	29
Unmanured	—	151	190	18
Bone Meal	25	181	227	21
Bone Meal Superphosphate	25	173	216	21
Ammoniacal Superphosphate	22	177	199	20
Peru Guano	16	181	209	17
Unmanured	—	168	194	16
Bone Guano Superphosphate	31	194	242	17
Animal Manure	17·5	172	213	18
Stable Dung	1100	194	233	23
Mejellon Guano Superphosphate	29·5	170	200	14

"The above table shows that Chili saltpetre, and next to it, stable dung and bone guano superphosphate, produced the best yields. Further researches are necessary to establish any conclusions from the above."

"Absorptive Power of Soil Constituents for Gases. By G. Ammon (Bied. Centr. 1879). The substances used in these experiments were sand, kaolin, carbonate of lime, hydrated oxide of iron, gypsum, clay, and humus, all powdered to various degrees of fineness. The author tried the effect of aqueous vapor and ammonia on these substances at various temperatures; his experiments shewing that the most favourable temperature for absorption lay between 0° and 10° c. and that the quantity absorbed varied directly with the finenesss to which the substance had been powdered.

"The following are the numbers obtained, 100 cubic centimetres of each substance being used, and the water being calculated by volume in state of gas."

I only give the results of the experiments at the two highest temperatures, as these come nearest to the Ceylon temperatures.

"Cubic centimetres of water vapour condensed by 100 c.c. of

At	Humus.	Hydrated oxide of iron.	Quartz.
20°c (68°F)	26,789	98,990	277
30°c (86°F)	16,497	54,753	99

Carbonate of Lime.	Kaolin.
962	1,541
233	1,335."

From these figures it is easy to see how valuable oxide of iron and humus must be in our Ceylon soils to enable them to resist drought.

"Of ammonia gas 0°c. the following quantities were absorbed :—

By humus.	By hydrated oxide of iron.	By Quartz.
29,517	38,992	938

By carbonate of lime.	By Kaolin.
1,552	2,447."

The greater absorptive powers of oxide of iron and humus are again very marked ; but the experiments having been made at the freezing temperature the absorptive powers of all are of course greatly higher than at temperatures prevailing in Ceylon.

"To show the influence of oxide of iron on the absorption of nitrogen by the soil, the author made the following determinations, in which ferruginous sand and clay, and the same substances freed from iron are compared in their absorptive power for nitrogen.

100 c.c. of sand	containing iron	absorbed	217 c.c.	nitrogen.
do	pure	,,	101 c.c.	,,
100 c.c. of kaolin	containing iron	,,	1,687 c.c.	,,"
do	pure	,,	846 c.o.	,,

In the absorption of the oxygen, gypsum stands higher than oxide of iron and next to it for the condensation of nitrogen.

I trust the forgoing may be of interest to some of your readers. M. C.

SHINGLING.

Not one half the persons who lay shingles when making a roof on a building have any correct ideas in regard to making a roof that will be absolutely rain-tight during a driving storm of rain. We have frequently seen men shingling, who, when they would meet with a worthless shingle, say once in laying two or three courses, would lay this poor shingle among the good ones, saying, "It is only one poor shingle, one shingle cannot make a poor roof." But one poor

shingle will make a leaky one. If first-rate shingles are employed, and one poor one is worked in among every 100, that roof might about as well have been without any shingles. If any poor shingles are to be used, let them all be laid together near the upper part of the roof. The best of shingles will not make a tight roof if they are not properly laid, while the same shingles would make an excellent roof if laid as shingles should be laid.

The correct rule for laying shingles of any length, in order to form a roof leak-tight, is to lay the courses less than one third the length of the shortest shingles. For example, when shingles are 18 inches long, many of them will not be more than 17 inches in length. Therefore five inches is all that the course will bear to be laid to the weather with surety of forming a good roof. The shingles must be three thicknesses over the entire roof. If they are not three thicknesses —if now and then a shingles lack a quarter or half an inch of being long enough to make three thicknesses—there will in all probability be a leaky place in the roof at such a point. Moreover, when the lower courses lack half an inch of extending up far enough to receive the rain from the outermost course, in case the middle course were removed, it would be just as well to lay them seven or eight inches to the weather as to lay them only five, or five and a-half, inches. Many shingles are only 16 inches long, and many that are sold for 16 inches long will hardly measure 15 inches. In this case—if the roof be rather flat, say about one quarter pitch—four and a-half inches is as far as they should be laid to the weather. In case a roof were quite steep it might answer to lay the courses four and three-quarter inches to the weather.

When buildings are erected by the job, proprietors should give their personal attention to this subject. and see that jobbers do not lay the courses a half inch too far to the weather.

There is another important consideration which is too frequently overlooked in shingling, which is break ing joints. Careless workmen will often break joints within half an inch of each other, when the joints of the different courses come so close together, the roof will most certainly leak. Why should it not? There is nothing to prevent it during a heavy rain. Unless a roof is steeper than a quarter pitch much care should be taken to break joints not less than one and a-quarter inches. Let all workmen and helpers be taught the vast importance of rejecting every poor shingle, except when the upper courses are being laid.—*Canadian Mechanics' Magazine.*

LAND SUITABLE FOR COFFEE.

Shortly, it may be stated that as a general rule the best zone of latitude for coffee is 150 on each side of the Equator; of altitude from 3,000 to 4,500 feet. The deeper, freer and richer the soil is the better. It should be specially tested for phosphoric acid and potash. The latter will be in abundance if large forest is felled and burnt grass land must be very exceptionally good to grow coffee at all. An eastern or south-eastern exposure is good, but not always essential, Shelter from tearing wind, however, is of the utmost importance, and in windy situations should be secured either by leaving belts or planting fast growing Australian trees. I have done both on my high windy estate. A mean temperature between 65° and 70° or 73°, is desirable from 70 to 150 (100 best) inches of rain, well distributed,

RULES FOR THE TREATMENT OF LIBERIAN COFFEE.

1.

Obtain good fresh seed.

2.

Build a shed that will admit light and air, but exclude sun and rain.

3.

Prepare a compost, of equal proportions of loam, sand, and well rotted cowshed manure, and lay it in beds four inches deep in the shed, smooth the surface and lay the seed down, two to three inches apart, and cover with coir dust, or well rotted cinnamon scrapings, or, in the absence of either, with fine sand, in no case putting more of the covering matter than is necessary to exclude light from the seed.

4.

Put into a tub, holding from twenty to twenty-five gallons of water, one quart of quicklime, and a wine-glass of kerosine oil; stir the mixture, well and give the beds, through a watering-pan with a fine rose, just as much as will settle them, and repeat the operation as often as may be necessary to keep the surface moist. With this treatment of fresh and sound seed, the plants will begin to appear about the twentyfifth day.

5.

As soon as all the plants in a bed have thrown off the parchment husk, and fairly expanded the seed leaves, they may be transplanted into bambu baskets, nine inches deep, and six inches wide at the top (which I get

made for R10 per 1,000*). The baskets should be filled with the same compost as the beds, with a little more loam and a little less manure. They should be kept in the shed and regularly watered for ten days, after which they may exposed be to the morning sun, and taken in as soon as the leaves show any symptoms of drooping, but they may be left outside entirely as soon as they can stand the sun without drooping.

6.

The plants may be put out in the field when they have three pairs of leaves, but, of course, at the proper season, during the first rains of the monsoon. The advantage of the baskets are that they present little obstruction to the spread of the roots, and will be rotten thoroughly in a few months ; the plants never feel that they have been removed, or have their growth stopped for a day, saving thereby laborious shading, and a greater or less percentage of loss, according to the circumstances of the season.

7.

The size of the holes may be a matter of taste, but my opinion is, that they can hardly be too big ; a good practical size, however, is two feet cubic, which, filled with surface soil, gives the plant 13·824 cubic inches of the richest material the land afford, to forage in, before forced into it is greater effort, for the purpose of penetrating the regions beyonds, whereas an eighteen inch hole only gives 5·832 inches.

8.

As we have not yet learned what the lateral expansion of a full-grown tree may be, we cannot decide the proper distance apart : ten feet ought to be enough, if allowed to carry out their natural vertical developement, but if topped at seven feet it appears to me that ten feet may be ultimately found too close. It is clearly the nature of the tree to throw out no branches till it reaches a height of from two to three feet, and the tendency to grow suckers from every part of the main stem is much greater than in the case of the Arabian species, and, what is more, I have found it very seriously resent their removal. We will no doubt gather experience as we proceed, but for the present we, of necessity, work a good deal in the dark.

K. L. C. B.

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* Up-country planters pay R15 per 1,000 for plant baskets.—Compilers.